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TEACHER'S SOURCEBOOK FOR EXPLORING THE WORLD OF SCIENCE, AN INSTRUCTIONAL PROGRAM FOR THE PRIMARY GRADES USING TELEVISION.

NORTH CAROLINA STATE BOARD OF EDUCATION, RALEIGH

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THIS SOURCEBOOK FOR ELEMENTARY SCHOOL TEACHERS IS DESIGNED TO PROVIDE ASSISTANCE IN THE UTILIZATION OF SCIENCE PROGRAMS TELECAST OVER A STATE EDUCATIONAL NETWORK. PROVIDING STUDENTS WITH EXPERIENCES WHICH THEY MIGHT NOT OTHERWISE HAVE AND STIMULATING THEM TO ENGAGE IN ACTIVITIES WHICH THEY MIGHT NOT OTHERWISE DO ARE MAJOR OBJECTIVES OF THE PROGRAM. A PREPARATION PROGRAM FOR TEACHERS AND PARENTS PRECEDES EACH WEEKLY CLASSROOM PROGRAM. PREPARATION MATERIALS CONSIST OF (1) AN INTRODUCTION TO THE TOPIC TO BE CONSIDERED, (2) THE ACTUAL PROGRAM WHICH WILL LATER BE SHOWN TO STUDENTS, AND (3) A FOLLOW-UP OF THE LESSON WITH FURTHER DISCUSSION OF ITS CONTENT AND USE. SUBJECTS INCLUDED IN THE 31 WEEKLY PROGRAMS ARE THE NATURE OF SCIENCE, MAN AND HIS ENVIRONMENT, NON-LIVING THINGS, MOTION, ENERGY, THE EARTH AND ITS ATMOSPHERE, AND SPACE. FOR EACH OF THESE MAJOR UNITS INFORMATION ABOUT (1) OBJECTIVES, (2) MAJOR IDEAS, (3) THE TELEVISION PRESENTATION, (4) RELATED ACTIVITIES, (5) STUDENT AND TEACHER REFERENCES, AND (6) EDUCATIONAL FILMS IS PROVIDED. SOURCES OF EDUCATIONAL FILMS AND PHONOGRAPH RECORDS ARE APPENDED. (AG)

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Teacher's sourcebook for

exploring the world of science

AN
INSTRUCTIONAL PROGRAM
FOR THE
PRIMARY GRADES
USING TELEVISION

State Department of Public Instruction
Raleigh, North Carolina

SE003 114

TEACHERS' SOURCEBOOK
FOR

EXPLORING THE WORLD OF SCIENCE
An Instructional Program for the Primary Grades Using Television

INTRODUCTION

EXPLORING THE WORLD OF SCIENCE is an instructional program sponsored by the North Carolina Department of Public Instruction and was prepared for the Comprehensive School Improvement Project with the cooperation of the Division of Instructional Services.

This project provides three instructional resources for primary grade teachers. One of these is a series of 31 weekly televised programs which may be used in the classrooms. These programs are broadcast over the North Carolina Educational Television Network at the times and dates listed in the schedule which is included in this Sourcebook.

A second resource is a series of 32 weekly preparation programs for teachers and parents of the children who will be viewing the science programs in the classrooms. The purpose of these preparation programs is to provide a preview of each week's science program along with comments on its purposes and suggestions for its use. The dates and times of these preparation programs are also listed in the schedule which is included in this Sourcebook.

The third resource is this Sourcebook which is designed to assist teachers in their science instruction and in the use of the televised presentations.

OBJECTIVES

Teaching in the primary grades revolves around the experiences of the children. Reading, writing, spelling, arithmetic, social skill, and all other subjects are taught primarily in the context of experiences which the children have had and new experiences which can be provided for them.

The purpose of EXPLORING THE WORLD OF SCIENCE is to provide experiences for the children which they might otherwise not have; to show them things which they might otherwise not have an opportunity to see; to stimulate them to observe things which they might otherwise not notice; and to cause them to think about ideas which they might otherwise not consider; and, to motivate them to carry out activities which they might otherwise not do.

Although most of the experiences which will be provided by this instructional program will be related to science, the purpose extends far beyond the teaching of science. It extends to the use of these new experiences as a context in which all other important learning activities and skills can be presented, used, practiced, and perfected.

USING THE TELEVISION PROGRAMS

The series of weekly science programs is intended for use by teachers, not as a science course for their students but, rather, as only one segment of their overall instructional program.

Teachers should use the televised presentations to provide background information and to stimulate an interest in and curiosity about particular scientific topics. The televised presentations are intended to serve only as a "jumping off point" to experiences and activities which will involve the children, in not only scientific investigation and discovery, but also activities which involve the reading, number, and language arts skills which are so important in these early school years.

Many of the television programs in this series are designed to promote observations, interpretations, discussions, and expressions of opinion by the children during the course of the televised presentation. Teachers should be prepared to supervise these moments by calling on students and, if they wish, injecting additional questions. However, in every case, free expression should be encouraged. The children should be allowed to let their imaginations go and express any reasonable thought which occurs to them. During these answering and discussion periods, teachers should make an effort to withhold judgment on the correctness of ideas as long as they reflect a sincere effort by the children to apply thoughts and experiences to the problem which is presented. Whether the answer is right or wrong is less important than whether or not it is a reasonable reaction to the data which the student has at his disposal for forming the answer.

The format, setting, and approach of the television lessons are designed to promote the idea of exploring the unknown. The first lesson will take place in a completely dark setting signifying that, at that point, we know very little about the "world of science." Each week, as a new topic is explored, a symbol representing that topic will be placed in the background. Gradually, the "world of science" will become brighter and more meaningful as it is progressively occupied with familiar symbols. At the end of the series, in spite of the fact that the setting for the explorations is beginning to take form, there will still be many dark areas. This setting will be used to signify that, although much has been learned about the "world of science" through the explorations which were made, there are still many dark areas which need to be investigated. The challenge will then be presented for the children to explore even further to see what they can learn about the "world of science."

Teachers may use the television lessons in any way they feel these presentations might contribute to their instructional programs. Each teacher is encouraged to use her own initiative in adapting the television programs and Sourcebook materials to a type of overall curriculum which will be most appropriate to her community, school, class, and children.

PREPARATION PROGRAMS FOR TEACHERS AND PARENTS

As indicated on the SCHEDULE OF TELEVISION PROGRAMS which is provided in this Sourcebook, a Preparation Program for teachers and parents will be broadcast every Monday afternoon during this series. Each preparation program will consist of three parts. The first part will be an introduction to the topic to be explored during that week. The second portion will consist of the actual televised lesson which will be broadcast for use with the children later in the week. The third part will be a follow-up of the lesson and further discussion of its content and use.

The purpose of the first and third portions of the Preparation Program is to provide teachers and parents with additional information on the subject of the week's exploration, assistance in using the televised presentation, and information on resources, demonstrations, experiments, and other follow-up activities which can be used in connection with the televised lesson.

The second portion of the Preparation Program, the actual lesson for the children, is included to give teachers an opportunity to view it in advance of its use in the classroom. In this way, they will be better prepared to anticipate questions, to prepare the children for the lesson, to carry out discussion periods and activities during the televised lesson, and to provide appropriate follow-up activities.

USING THE SOURCEBOOK MATERIALS

This Sourcebook has been developed to provide teachers with information about each television EXPLORATION and to make available a variety of teaching resources. A guide is included for each EXPLORATION. Each guide is divided into seven general areas which, it is believed, are of interest and use to participating teachers.

Purpose

Since it is sometimes not readily apparent what the intentions of a particular lesson may be, the purposes of each television EXPLORATION are outlined briefly.

Main Ideas

Some of the important understandings which will be developed during the television EXPLORATION are listed.

Television Presentation

A brief description is provided indicating the nature of the television presentation in order to familiarize the teachers with both the content and the method of presentation.

Related Activities

Activities related to the topic are suggested. These activities are designed to emphasize not only scientific content and processes but, also, basic reading, number, language arts, and learning skills. It is hoped that at no time in the utilization of these activities will the teacher play the role of a source of information with ready answers to each student's questions. Rather, it is hoped that she will assume the role of a coordinator of learning activities.

Recent Books

In each school library there is a source of related reading materials. Such books as A SOURCEBOOK FOR ELEMENTARY SCIENCE (see the following section) provide excellent bibliographies of science books for children.

This section is devoted primarily to recent books. These books, published in the last few years, are favorably rated by a panel appointed by the American Association for the Advancement of Science.

These books have been graded according to three levels. Level A indicates books appropriate for preschool and first grade children. Level B designates books appropriate to the primary grades. Level C is used to indicate books at an intermediate elementary school level.

Teacher References

Three reference sources have been cited with each EXPLORATION. These references were selected as useful sources of instructional activities. The references are designated by numbers.

Reference
Number

1. Hone, Elizabeth, Alexander Joseph, Edward Victor, and Paul Brandwein. A SOURCEBOOK FOR ELEMENTARY SCIENCE. Harcourt, Brace and World, Inc., New York, 1962.
2. National Science Teachers Association. INVESTIGATING SCIENCE WITH CHILDREN. Teachers Publishing Company, Darien, 1964.
3. UNESCO. 700 SCIENCE EXPERIMENTS FOR EVERYONE. Doubleday and Company, Inc., Garden City, 1958.

Free Films

Many schools and school administrative units maintain film and filmstrip libraries which can be a valuable part of a teacher's instructional program. Additional films and film sources are listed in such references as A SOURCEBOOK FOR ELEMENTARY SCIENCE (see the previous section).

With each EXPLORATION there are listed films which are available without rental charges. These films can be borrowed with the only cost being the price of return postage. These films are recommended in the belief that in some cases an entire film and in other cases portions of a film can be useful to a participating teacher. It is essential that a classroom teacher preview a film in advance in order to assess its appropriateness for her particular class.

The addresses of the companies which provide the films are listed under Appendix A at the end of this Sourcebook.

OUTLINE OF CONTENT OF TELEVISION PROGRAMS

The following outline is prepared to provide teachers with an overall view of the curriculum pattern which will be followed in the series of television presentations. It is important that teachers realize that the responsibility for the instructional program in their classrooms is totally theirs. Maximum flexibility is encouraged in the use of the television presentations, the curriculum structure in which they are used, and the topics which are explored following the television programs.

For example, 10 different classes could study 10 entirely different phases of plant life following a television program on plants. Still another teacher might consider it more appropriate to launch an immediate study of animals without further discussion of plants. All of these approaches could be considered equally valid in the context of the situations in which they are being used.

The pattern of the curriculum structure follows an explanation of science which begins with the individual and things close to him and works away to greater and greater distances, ending with a study of space.

EXPLORING THE WORLD OF SCIENCE

I. Exploring Science
II. Exploring Ourselves
    A. Ourselves as living things
    B. Requirements for life
    C. Responses to our environment
III. Exploring Our Surroundings
    A. Living things
        1. Nature of living things
        2. Characteristics and needs of plants
        3. Characteristics and needs of animals

- B. Non-living things
  - 1. Types of non-living matter
  - 2. The nature of matter
  - 3. Forms of matter
  - 4. How types of matter interact
- C. Motion
  - 1. Matter in motion
  - 2. Factors which produce motion
  - 3. Factors which deter motion
- D. Energy--the source of motion
  - 1. Kinds of energy
  - 2. Mechanical energy
  - 3. Wave energy
  - 4. Heat energy
  - 5. Electrical energy
- E. The earth we live on
  - 1. Rocks and soil
  - 2. The hydrosphere
  - 3. Changes in the earth
- F. The air around us
  - 1. Air
  - 2. Weather phenomena
  - 3. Weather forecasting and instruments

IV. Exploring Space
- A. Makeup of the solar system
- B. Makeup of the universe
- C. Tools for exploring space
- D. Rockets
- E. Space flights

V. Exploring Science

ENVIRONMENT AND FACILITIES FOR VIEWING TELEVISION IN THE CLASSROOM

Essential to an effective use of television in the classroom is adequate preparation of the physical facilities for viewing television programs. Because of the wide variety of situations in which television is used, it is difficult to establish comprehensive rules for such preparation. However, a few general suggestions may prove to be helpful.

Be sure that the television set is in good repair. If it isn't, contact your school district maintenance department or a local repairman for needed adjustments. Attempting to watch a television set which is not working properly can often do more harm than good. A distinct picture and clear sound are essential.

If your school needs a new television set, discuss with your principal the possibility of purchasing one. There are several sources of funds (NDEA, ESEA, etc.) which can be applied to such a purchase if your school qualifies.

Be certain, also, that you have an adequate antenna. In some areas, "rabbit ears" perform satisfactorily. However, if "rabbit ears" are not consistently dependable, an outside antenna can be installed inexpensively. Insure, however, that this installation is performed by a qualified individual who can assure you of the maximum possible benefit from this equipment. For those schools which are on the "fringe areas", a special directional antenna can be installed which can be directed toward and tuned to the educational channel.

For the use of this series, it is preferred that a single television set be used with a single class. However, if two or more classes come together to view a program, careful consideration must be given to a seating arrangement which will insure that each child has a satisfactory view of the television set. In some cases, it may be desirable to have more than one set in a room or to divide the large group into smaller groups in separate rooms with separate sets.

A careful check of lighting should be made to eliminate glare on the television screen. This can be accomplished by adjusting overhead lights and window shades. Care should be taken, however, not to darken the room completely and not to obstruct adequate ventilation.

Questions which arise relative to the proper physical environment and technical facilities for viewing television should be directed to the Supervisor of Television Education, State Department of Public Instruction, Raleigh, North Carolina.

SCHEDULE OF TELEVISION PROGRAMS

The following schedule provides the dates on which all television programs in this series will be broadcast. The "Preparation Programs", which will be directed toward the teachers and parents, will be broadcast at 3:00 p.m. over the North Carolina Educational Television Network. The "Explorations", which are designed for use in primary grade classrooms, will be broadcast at 1:00 p.m.

September 25	Preparation Program - Introduction
October 2	Preparation Program - Exploration I
October 3 and 5	Exploration I
October 9	Preparation Program - Exploration II
October 10 and 12	Exploration II
October 16	Preparation Program - Exploration III
October 17 and 19	Exploration III
October 23	Preparation Program - Exploration IV
October 24 and 26	Exploration IV
October 30	Preparation Program - Exploration V
October 31 and November 2	Exploration V
November 6	Preparation Program - Exploration VI
November 7 and 9	Exploration VI
November 13	Preparation Program - Exploration VII
November 14 and 16	Exploration VII

THANKSGIVING HOLIDAYS

November 27	Preparation Program - Exploration VIII
November 28 and 30	Exploration VIII
December 4	Preparation Program - Exploration IX
December 5 and 7	Exploration IX
December 11	Preparation Program - Exploration X
December 12 and 14	Exploration X

CHRISTMAS HOLIDAYS

January 1	Preparation Program - Exploration XI
January 2 and 4	Exploration XI
January 8	Preparation Program - Exploration XII
January 9 and 11	Exploration XII
January 15	Preparation Program - Exploration XIII
January 16 and 18	Exploration XIII
January 22	Preparation Program - Exploration XIV
January 23 and 25	Exploration XIV
January 29	Preparation Program - Exploration XV
January 30 and February 1	Exploration XV

February 5	Preparation Program - Exploration XVI
February 6 and 8	Exploration XVI
February 12	Preparation Program - Exploration XVII
February 13 and 15	Exploration XVII
February 19	Preparation Program - Exploration XVIII
February 20 and 22	Exploration XVIII
February 26	Preparation Program - Exploration XIX
February 27 and 29	Exploration XIX
March 4	Preparation Program - Exploration XX
March 5 and 7	Exploration XX
March 11	Preparation Program - Exploration XXI
March 12 and 14	Exploration XXI
March 18	Preparation Program - Exploration XXII
March 19 and 21	Exploration XXII
March 25	Preparation Program - Exploration XXIII
March 26 and 28	Exploration XXIII
April 1	Preparation Program - Exploration XXIV
April 2 and 4	Exploration XXIV
April 8	Preparation Program - Exploration XXV
April 9 and 11	Exploration XXV
April 15	Preparation Program - Exploration XXVI
April 16 and 18	Exploration XXVI
April 22	Preparation Program - Exploration XXVII
April 23 and 25	Exploration XXVII
April 29	Preparation Program - Exploration XXVIII
April 30 and May 2	Exploration XXVIII
May 6	Preparation Program - Exploration XXIX
May 7 and 9	Exploration XXIX
May 13	Preparation Program - Exploration XXX
May 14 and 16	Exploration XXX
May 20	Preparation Program - Exploration XXXI
May 21 and 23	Exploration XXXI

COMMUNICATIONS, QUESTIONS AND COMMENTS

Comments on, questions about, and reactions to this instructional program are eagerly sought. Correspondence should be directed to Television Education Office, Exploring the World of Science, Department of Public Instruction, Raleigh, North Carolina 27602. Please keep in touch!

EXPLORATION I

WHAT IS SCIENCE?

Purpose

The purpose of this lesson is to stimulate the children to think about what science is and what scientists do.

Main Ideas

1. Scientists do many different kinds of work.
2. Scientists work in many different types of places.
3. Both men and women are scientists.
4. Scientists learn in many different ways.
5. Scientists are interested in studying everything around us.
6. Scientists learn about things in many of the same ways that children learn.

Television Presentation

This televised exploration will be approached in three general segments in which the children are to actively participate. In the first segment, they will view scientists at work and guess what they think the scientists are doing. What the scientists are actually doing is not important. Any reasonable answer should be accepted. The really important thing is that the children will have a contact with evidence of the first four ideas given above.

The second segment will give them an opportunity to explore their surroundings with a child their age and to suggest things which they see that scientists study. The ideas which they suggest are of secondary importance. Any reasonable answer should be accepted. What is important is the background given for the formation of the fifth idea given above.

The third segment will give the children an opportunity to see and suggest the ways that they learn. It will then become evident that they learn in many of the same ways that scientists do.

Jumping Off Point

The children should come to realize that since scientists study everything around them and since scientists use the same ways of learning which they do, science is not a remote thing but, rather, something that is close and familiar. How, then, can they learn more about science and become better at learning in the same ways that scientists do?

Related Activities

1. How do scientists learn through observation and experimentation?

The following activity can be carried out with one set of materials for the entire class, with several sets of materials for small group work, or with one set of materials for each child. The following description can be revised to fit the type of grouping which the teacher chooses to use.

Obtain a box. Any size will do. The approximate size of a cigar box is convenient. Place several objects of different sizes, shapes, materials, and possibly one with an odor in the box. Seal it shut. Pose the problem to your students to describe the box in as much detail as possible. This will require looking at it, feeling it, lifting it, and even smelling it.

In order to determine the contents of the box without opening it, the children will have to devise a lot of experiments and carry them out. For example, a round object in the box will roll in all directions, a cylindrical object will roll in one direction but when tilted at a right angle it will not roll, and an object with a flat side will slide. When the box is shaken, metal and glass objects will tinkle upon striking one another. A magnet will hold certain metal objects in a position from which they will fall or slide when the magnet is moved.

The type and number of observations and experiments are limited only to the ingenuity of the children. This activity should enable them to understand how it is possible to gather information about something which is unknown and even unseen.

In addition to participating in the activity, the teacher may also have the children record their observations and experimental results in writing.

2. How do scientists learn through observation and experimentation?

The following activity can be carried out with an entire class, with small groups, or with individual children. The following description can be revised to fit the type of grouping which the teacher chooses to use. CAUTION: Since an open flame will be used, the teacher should plan the activity in such a way as to minimize the possibility of accidents.

Begin with an unlighted candle. Through any means at your disposal, learn as much as possible about the candle. If possible, make a list of these observations. Included can be such things as length, diameter, color, material makeup, etc.

Light the candle. Again, through experimentation, measurement, and observations, record as many facts about the candle as possible. There is no limit to the kind of things that can be explored. What is the flame like? How long will it burn when covered with a quart jar? How long will it burn when covered with a gallon jug? Is there any relationship between the last two questions? How close can you hold your hand above the flame? Keep asking questions and finding a way to answer them.

Compare observations about the candle after you put it out to the observations which were made before lighting it.

3. What can scientists tell us about their work?

Invite a scientist from the community to the classroom to answer questions about science and the scientist.

4. What do books tell us about what scientists study and do?

Have the children look through as many books about science as they can find and make a list of the things which these books are about.

5. What do books tell us about what scientists study and do?

Have the children look in the school library and other libraries available to them. See how many books they find about science. Have them list the ones which they like the best so they can tell their classmates about them. If scientific experiments are suggested which the children can prepare, have them present them to the class.

6. What do scientists study and do?

Have the children list all of the things which they see during a particular day that scientists study and learn about. The following day, compare and discuss lists.

7. What kind of work do scientists do?

If there is a university, college, industry or research center near your school, arrange to visit it in order to have the children see scientists, the equipment they use, and the work that they do.

Recent Books

Level	
A	Bendick, Jeanne. WHAT COULD YOU SEE? Whittlesey. $2.50.
C	Freeman, Mae and Ira. FUN WITH SCIENTIFIC EXPERIMENTS. Random. $1.95.
C	Herbert, Don (Revised by A. Joseph). MR. WIZARD'S SCIENCE SECRETS. Hawthorn-Popular Mechanics. $3.95.
C	Milgrom, Harry. EXPLORATIONS IN SCIENCE. Dutton. $3.00.
C	Milgrom, Harry. FURTHER EXPLORATIONS IN SCIENCE. Dutton. $3.00.
A	Schwartz, Julius. I KNOW A MAGIC HOUSE. Whittlesey. $2.75.
B	Science Center, National College of Education. YOUNG PEOPLE'S SCIENCE DICTIONARY. Children's Press. Chicago. 1964. $4.95.
A	Sonnburn, Ruth. THE QUESTION AND ANSWER BOOK OF EVERYDAY SCIENCE. Random. $1.95.

Teacher References

1. Sourcebook, entire book.
2. NSTA, entire series.
3. UNESCO, entire book.

Free Films

1. About Time, 60 min., Bell System Telephone Offices.
2. Assignment-Weights and Measures, 18 min., National Bureau of Standards.
3. A Light in Nature, 33 min., Shell Oil Company.
4. Mr. Bell, 36 min., Bell System Telephone Offices.

EXPLORATION II

WHAT CAN WE LEARN ABOUT OURSELVES?

Purpose

The purpose of this lesson is to introduce each child to a better understanding of himself and to stimulate him to explore his relationship to his environment.

Main Ideas

1. We differ in many ways from non-living things.
2. We have much in common with other living things.
3. We have more in common with animals than with plants.
4. People differ from one another but have many things in common.
5. Similarities and differences serve as a basis for classification.

Television Presentation

During the televised lesson, the children will be shown a rock, a plant, an animal, and a boy. While viewing each item, the children will first be asked in what ways it is like them and then in what ways it differs from them. Time will be provided following each question to allow several answers to be suggested by the children. The teacher should be prepared to allow the children to suggest answers but to reserve judgment concerning the correctness of these answers pending further discussion.

Jumping Off Point

Having seen how he resembles and how he differs from other things, the opportunity is present to have each child realize in what ways he is unique as an individual and also how he can be compared and classified with other people, living things, and inanimate objects.

Related Activities

1. In what ways are we the same as, and in what ways do we differ from, the things around us?

Have the children analyze the similarities and differences between themselves and things around them. Anything can be used. A rock, a house, a plant, a rabbit, a hampster, a doll, and a statue are all examples of the types of things which would lead to interesting observations and analysis.

The opportunity is available in this activity to develop and employ a wide variety of skills and learning activities. Observation, measurement of size, measurement of weight, identification of color, analysis of texture, use of reference materials, differentiation, and critical thinking are but a few of the many important procedures which can be used in this activity.

If several things are analyzed, an opportunity is available to lay a foundation for developing a concept of classification. What items are alike, what items are different, and how do they fall into some sort of logical groupings?

2. In what ways are we the same and in what ways do we differ from each other?

Have the students list the ways in which they are the same. Then have them list and analyze ways in which they differ. Aside from the usual qualitative answers which can be given, some rather interesting quantitative analyses can be made, some of which relate to skills and learnings in other areas.

A variety of measurements can be made. An introduction to the preparation of graphs can be developed by, for example, taking strips of paper the height of each student and lining them up, in order of height, along a wall. It can be pointed out that this not only shows differences but provides a convenient picture (a graphic representation) of these heights.

Differences in jumping ability, running speed, and singing range are a few more of many types of things which can be analyzed and compared in unique ways.

3. How can people be divided into classifications?

Stress the importance of organizing, arranging, and classifying in order to have a better understanding. To give the children some practice in classification, have the children divide themselves into two groups according to some characteristic. It may be according to sex, height, weight, color of hair, or anything they want. Then, have them subdivide each of the two groups into two more groups according to one of the other characteristics. Continue with subdivisions as long as possible.

Was this the only way that the classification could have been accomplished? Have them start with a different characteristic from the one that they began with before and repeat the procedure. An opportunity is available to impress them with the idea that there are a lot of ways to divide and classify. What is the best way? That, of course, depends on which one is most useful.

Recent Books

Level

C Cosgrove, Margaret. A IS FOR ANATOMY. Dodd, Mead. New York. 1965.

C Glemser, Bernard. ALL ABOUT BIOLOGY. Random House. New York. 1964. $1.95.

C McGovern, Ann. THE QUESTION AND ANSWER BOOK ABOUT THE HUMAN BODY. Random. New York. 1965. $1.95.

C Schuman, Benjamin. THE HUMAN SKELETON. Atheneum. New York. 1965. $3.50.

B Showers, Paul. YOUR SKIN AND MINE. Crowell. New York. 1965. $2.95.

C White, Anne Terry and Gerald S. Lietz. SECRETS OF HEART AND BLOOD. Garrard. Champaign. 1965.

C White, Anne Terry and Gerald S. Lietz. WINDOW ON THE WORLD. Garrard. Champaign. 1965.

Teacher References

1. Sourcebook, Chapters 13, 14.
2. NSTA, Volume 1, Living Things.
3. UNESCO, Chapter XVII.

Free Films

Linnaeus (Classification), 18 min., Swedish Film Center.

EXPLORATION III

WHAT DO OUR BODIES NEED TO GROW STRONG AND HEALTHY?

Purpose

The purpose of this lesson is to prompt children to become more aware of the parts, needs, and capabilities of their bodies.

Main Ideas

1. Our bodies are made up of many parts which work together.
2. A healthy body needs rest.
3. A healthy body needs the proper foods.
4. A healthy body needs to be kept clean.
5. A healthy body needs exercise.

Television Presentation

By comparing our bodies to a rag doll, the body systems and their functions will be explored. Then, from an outline of a man, puppet characters representing various systems of the body will emerge and tell about their functions and needs. Finally, several pictures will be shown of children doing things which are important to the care of the body. Teachers should be prepared to allow the children in their classrooms to describe the action which they see in each picture.

Jumping Off Point

The children should have gained some insight into the complexity, functions, and needs of the human body. What habits and procedures can they develop to grow strong and healthy? Why are these habits and procedures important?

Related Activities

1. What are some parts of the body and what does each one do for us?

List the names of the parts of the body which are visable on the outside of the body. What does each part do?

2. What is inside our bodies and what happens there?

List the names of some of the parts of the body which are inside the body. What does each part do?

3. What do internal body parts look like?

Obtain from farmers, butcher shops, or the dinner table, things which can be examined to help the children better understand the structure of the body. Bones, hearts, livers, and a wide variety of other animal parts are readily available. Examine and discuss.

4. Do you eat the proper foods each day?

Have the children keep a record of all of the food which they eat over a period of time. A variety of activities can be carried out in connection with such a list. Calories can be counted and compared with tables of normal calorie requirements. Lists of vitamins and minerals eaten each day can be kept.

5. What are some of the important foods that our bodies need?

Locate a list of important vitamin and mineral requirements and the foods which provide them. Prepare a chart for each of these with the name of the vitamin or mineral at the top and allow the children to cut pictures of representative foods from magazines and paste them on the charts.

6. How does exercise affect the body?

Have each child locate his pulse and count his rate of pulse beat over a period of time. Then have each child hop up and down on one foot for about thirty seconds and count his pulse rate immediately thereafter. What happens? Check the pulse again after sitting quietly for about five minutes after the exercise. Discuss.

7. Who can help us keep our bodies healthy?

Invite the school nurse or a public health nurse to visit the class and answer questions.

8. How can we gain information about diseases?

Have the children write letters to various local agencies such as the heart association, tuberculosis association, Red Cross, etc. for information on diseases.

9. How much rest do our bodies need?

Have each child keep a record of the number of hours which he sleeps each night. These records can be used for comparison with normal requirements. The concept of averages can be approached for each individual over a period of time or for the entire class. Determination of the mean, median, and mode figures would be worthwhile activities to approach.

10. What types of exercise do our bodies need?

Consult your local physical education supervisor for a suggested program for physical development to be begun and carried out during the year.

Recent Books

Same as Exploration II.

Teacher References

1. Sourcebook, Chapters 13 and 14.
2. NSTA, Volume 1, Living Things.
3. UNESCO, Chapter XVII.

Free Films

None

EXPLORATION IV

HOW DO WE LEARN ABOUT OUR SURROUNDINGS?

Purpose

The purpose of this lesson is to make the children aware of the nature and capabilities of their senses and to provide practice in expressing verbally their sensory perceptions.

Main Ideas

1. We become aware of our surroundings by means of our senses.
2. The senses which enable us to become aware of our surroundings are seeing, hearing, feeling, tasting, and smelling.

Television Presentation

The televised lesson will be devoted to using the senses to see, hear, feel, taste, and smell. As this is done the children will be given an opportunity to express to their teachers what they believe is being seen, heard, felt, tasted, and smelled.

Jumping Off Point

Having become aware of what the five senses are, how can we learn more about each one and in what ways can our senses both inform us and deceive us?

Related Activities

1. How good are your eyes?

Invite the school nurse to bring an eye chart to the classroom, show how it is used to test eyes, and perhaps take time to test the children's eyes.

2. What devices can be used to help the eyes do their job better?

Collect and demonstrate such devices as binoculars, microscopes, magnifying glasses, etc. which can be used to assist the eyes to better do their job.

3. How do our eyes sometimes deceive us?

Locate a book which contains optical illusions. Use these to demonstrate how our sense of sight can often deceive us.

4. How good are your ears?

If the school nurse has access to equipment for testing ears, this would be a good time to invite her to bring it to class. If time permits, the children's ears could be tested.

5. How does your sense of feeling operate?

In order to have the children gain a better understanding of the role which nerve endings play in sensing touch, heat, cold, and pain, have each child mark off an area on the back of the first joint of the middle finger. Using a sharpened pencil, have them carefully press the point firmly against the skin at many places within the area. Have them experiment to determine the places within the marked area which produce each of the sensations mentioned. CAUTION: Do not carry out this activity if you believe that there may be any danger of the children injuring themselves.

6. What different types of things are we able to taste?

Prepare solutions of salt (tablesalt), sweet (sugar), sour (lemon), and bitter (alum). Using toothpicks which can be disposed of after use, dip them in the solutions and have the children taste them and determine what they are. These are the four different tastes which we are capable of distinguishing.

7. How do we taste things?

Different parts of the tongue are sensitive to different tastes. Using the same solutions as prepared for Activity 6, apply them to various parts of the tongue with toothpicks and use a drawing to show the parts of the tongue which are most sensitive to each taste.

8. How can we identify objects by their odors?

Blindfold a child and have him identify a variety of things by their odors. Foods, plants, perfume, etc. can provide a source of objects.

9. How do our senses protect us?

Have the children discuss and list ways in which our senses warn us of danger and protect us from injury.

10. How can our sense of feeling deceive us?

Line up three bowls. On one end put ice water. On the other end, put water which is as hot as you can stand putting your hand into. In the middle, put water which is about at room temperature. Have the children put one hand in the hot water and the other hand in the cold water. Then have them move both hands to the center bowl. What are the results? Discuss and explain.

Recent Books

Level

C White, Anne Terry and Gerald S. Lietz. WINDOW ON THE WORLD. Garrard. Champaign. 1965.

Teacher References

1. Sourcebook, none.
2. NSTA, none.
3. UNESCO, Chapter XVII.

Free Films

None

EXPLORATION V

HOW ARE LIVING THINGS DIFFERENT FROM NON-LIVING THINGS?

Purpose

The purpose of this lesson is to develop an awareness by the children of the characteristics of living things and how living things can be classified.

Main Ideas

1. Living things can be characterized by responsiveness, growth, reproduction, nutrition, and life span.
2. It is convenient to divide living things into classifications. All living things are commonly divided into the two major classifications, animals and plants.
3. Animals and plants can be distinguished from one another by certain distinctive characteristics.

Television Presentation

During this lesson, the children will be led to consider a mouse, a plant, a roller skate, and a brick. They will be asked to tell their teachers the characteristics which they are able to perceive in each. These observations will serve as a basis for developing an understanding of differences between living and non-living things and also as a foundation for classification of things around us.

Jumping Off Point

Following an introduction to the characteristics of living things and how these characteristics can be used in classification, the next step is to have the children observe the characteristics of all kinds of living things and gain experience in devising classifications.

Related Activities

1. What are the characteristics of living things?

Collect some living things. Observe them over a period of time and see if you can recognize evidence of the characteristics of living things. Insects, other small animals, and plants are good specimens.

2. How can animals be classified into groups?

Have the children list as many animals as they can think of. Then, have them independently, or in small groups, arrange these animals into classifications or groups according to common characteristics. Compare the methods of classification and allow the children to discuss their reasons for approaching the problem in a particular way. A lively discussion will provide many insights into the advantages, disadvantages, and problems in classification.

If possible, it would be helpful if the children could locate pictures of the animals to assist them in this activity.

3. How can plants be classified into groups?

Follow the same procedure as described in the previous activity but this time use plants instead of animals.

4. How can you prepare to study living things?

Since the next few weeks will be spent in learning about living things, prepare places in the classroom to keep plants, small animals, insects, and other living things.

5. How rapidly do things grow?

If a plant or small animal is to be kept in the classroom over a long period of time, devise a way to measure its growth regularly (weight, length, height, or some other characteristic) and show this information on a chart of some kind. A picture graph would be ideal for showing differences and developing the idea of graphing.

6. What factors affect the growth of plants?

Using several plants of the same kind, have the children devise experiments to determine the effect of heat, cold, light, darkness, water, fertilizer and other factors upon the growth of a plant. This will provide experience in devising a controlled experiment.

7. How are new living things produced?

Through references, observation, and asking questions, have the children explore how all the living things around them are reproduced. Key ideas such as sexual reproduction, asexual reproduction, seeds, egg laying, and live bearing should be included.

8. How do the life spans of different living things vary?

Have the children consult references to determine the average life spans of various living things. Have them prepare a chart which compares these life spans by some graphic means.

If the children cannot read, information can be given them and the combination of a picture of the animal and length of life span can be brought together on a chart.

9. How do certain living things respond to light?

Have the children devise experiments to determine how moths, earthworms, and green plants respond to light. Other living things can also be used and records kept.

Recent Books

Level

C Glemser, Bernard. ALL ABOUT BIOLOGY. Random House. New York. 1964. $1.95.

C Ubell, Earl. THE WORLD OF THE LIVING. Atheneum. New York. 1965.

Teacher References

1. Sourcebook, Chapters 2, 3, 4, 5, and 6.
2. NSTA, Volume 1, Living Things.
3. UNESCO, Chapters III, IV, and XVII.

Free Films

Linnaeus (Classification), 18 min., Swedish Film Center.

EXPLORATION VI

WHAT CAN YOU LEARN ABOUT PLANTS?

Purpose

The purpose of this lesson is to stimulate the children to make observations and perform experiments which will enable them to learn more about the variety of parts, functions, and types of plants.

Main Ideas

1. Plants vary in types.
2. Some plants grow from seeds.
3. Roots hold plants in the soil and take in water and minerals for the plants.
4. Stems hold the leaves up to the light and carry water from the roots to the leaves.
5. Leaves make food by using air, water, and sunlight.
6. There are many different shapes and forms of leaves.

Television Presentation

The children will be shown films of portions of various plants and will be given an opportunity to identify the parts. They will then be shown examples of different types of plants. The important parts of plants will be discussed along with an explanation of the function of each. Finally, experiments will be suggested which the children can do to learn about the needs of plants and the reactions of plants to their environments.

Jumping Off Point

The televised presentation is intended to introduce the children to the subject of plants and the types of observations and experiments which they can carry out with plants. The important learning experiences will come when the children actually engage in these activities.

Related Activities

1. From what do plants grow?

Using lima bean seeds obtained at a seed store, have each child describe the outer structure in as much detail as possible. Descriptions can include such things as color, size (measure dimensions), shape, etc. Then place all of the beans in a jar of water and allow them to soak overnight. The next day, after the beans have softened, redistribute them to the children, have them break the seeds open and describe what they find inside. Descriptions can be made orally, in writing, with drawings, or in any way the teacher desires. CAUTION: Use seeds which are free of insecticide.

2. Under what condictions will a seed best germinate and grow?

This activity is designed to provide an opportunity for children to devise and carry out an experiment. The teacher should pose the question, what conditions are most favorable for seed germination and growth? Allow the children to suggest as many conditions as possible. Will they grow best in heat or cold; in light or in dark; dry, moist, or wet; in soil, sawdust, cotton, or plain water; or any other of a variety of conditions which may be described?

Using paper cups or milk cartons and lima bean seeds, experiments can be devised for answering the questions. For example, two seeds may be put into dry soil in a paper cup, two seeds in moist soil, and two seeds in very wet soil and the results observed. Or, two seeds may be put in each of two identical cups with soil of identical moisture but one of the cups be left in the light and the other covered with a box to keep it dark. In similar experiments, the relative effects of temperature, depth, material planted in, etc., can be tested. The results can be merely observed or recorded in writing from day to day and, if a book on the subject can be located, the experimental results can be checked against the results of other experiments.

3. What are the parts of a flower and what use do they have for the plant?

Have the children examine flowers from several different plants and see if they can find certain features that most of the flowers have in common. Have them search for answers to what these features are and what purposes they have.

4. How can plants be classified into groups?

Have the children list as many plants as they can think of. Then, have them independently, or in small groups, arrange these plants into classifications or groups according to common characteristics. Pictures of the plants would help. Compare the methods of classification and allow the children to discuss their reasons for approaching the problem in a particular way. A lively discussion will provide many insights into the advantages, disadvantages, and problems in classification.

5. How do leaves of different trees vary in size and shape?

Have the children collect, press, mount, label and display the leaves of various trees. Refer to books for identification of unknown leaves.

6. How do stems carry water to the leaves?

Secure three pieces of celery. Cut off about an inch or two of the stems. Place one piece in a glass of clean water, one piece in red ink, and one piece in blue ink.

Examine the celery from time to time during the next few days. Then remove the celery from the glasses and cut across the stems with a knife. Examine the cut ends of the stems carefully. A magnifying glass will be very helpful. What do you observe? What happened? Explain.

7. What conditions are important to plant growth?

Have the students list all of the factors which they consider important to plant growth. The list could include such things as temperature, light, moisture, etc. Have the students devise experiments to test each of these conditions. Tests should involve using several samples of a particular plant which are similar and comparing the effects of various factors upon them. An opportunity to make measurements and record observations is available in this activity.

8. Can you identify plants around you?

Take the class for a walk in a nearby field or woods. Have the children identify as many trees and plants as possible. Take books and field manuals to assist you. Point out the features, such as flowers, leaves, bark, etc., which are most commonly used in identifications.

9. Where are seeds found in different plants?

Have the children bring as many examples of seeds as they can find. If possible, have them identify the plant from which each seed came. Fruits, vegetables, nuts, flowers, weeds, and many other sources are readily available to them. The opportunity is available for writing lists, labeling, measuring the largest and smallest, identifying with books, and many other activities which involve language arts and number skills.

Recent Books

Level

A Alili. A WEED IS A FLOWER: THE LIFE OF GEORGE WASHINGTON CARVER. Prentice-Hall. Englewood Cliffs. 1965. $4.25.

B Allen, Gertrude. EVERYDAY WILDFLOWERS. Houghton Mifflin. Boston. 1965. $2.75.

B Lerner, Sharon. I FOUND A LEAF. Lerner. Minneapolis. 1964. $2.75.

C Lubell, Winifred and Cecil. GREEN IS FOR GROWING. Rand McNally. Chicago. 1964. $2.95.

Teacher References

1. Sourcebook, Chapters 4, 5, and 6.
2. NSTA, Volume 1, Living Things.
3. UNESCO, Chapter III.

Free Films

1. How to Collect and Preserve Plants, 13 min., Illinois Natural History Survey.
2. How to Plant a Small Shade Tree, 12 min., Smithsonian Museum Service.
3. Life of the Molds, 21 min., Sterling-Movies U.S.A., Incorporated.
4. Linnaeus (Classification), 18 min., Swedish Film Center.
5. What's Behind a Rose, 20 min., Roses, Incorporated.

EXPLORATION VII

WHAT CAN YOU LEARN ABOUT ANIMALS?

Purpose

The purpose of this lesson is to stimulate the children to make observations and perform experiments which will enable them to learn more about animals.

Main Ideas

1. Animals vary in types.
2. Animals vary in the way they bear and care for their young.
3. Animals live in a wide variety of habitats.
4. Animals obtain food from living things found in their habitats.
5. Some animals can be kept as pets.

Television Presentation

The television lesson will be based on recognizing the characteristics of animals and using similarities and differences as a basis for classification. Opportunities will be provided for the children to perform some simple exercises in classification. A few different types of animals will be shown and discussed in order to illustrate characteristics which are used in classification.

Jumping Off Point

On the basis of the background which has been presented, the way is paved for observation and experimentation on the characteristics, habits, and classification of animals.

Related Activities

1. In what ways do animals vary?

Have the children list as many animals as they can think of. If they can locate pictures of these animals, it would be helpful. Then have them list, in as many ways as possible, the ways in which these animals differ from one another. An opportunity is available to relate these differences to differences in the habitats in which they live.

2. What are the habits, characteristics and needs of animals?

Arrange to have the students observe an animal or different animals for extended periods of time. This can be accomplished in a variety of ways. Fish can be observed in an aquarium or a jar; frogs and snakes can be observed in a terrarium; bird feeders can be placed outside the school window for bird observation; hampsters, white mice, white rats and guinea pigs can be observed in cages in the classroom; ants can be viewed through the walls of observation nests; bees can be observed in special observation beehives; and a variety of other animals can be brought into the classroom for extended observation by the children.

Notes can be made concerning the food eaten, adaptations for getting food, adaptations and methods for eating food, how the animal moves about, its size, shape, coloring, reasons for coloring, cooperation between animals, fighting among animals, special characteristics, reproduction, etc. Books may be consulted to gain information on what to look for and possible explanations of observed behavior.

3. What kinds of birds visit your neighborhood?

Have each child begin to keep a bird list. The name of the bird, the date and the location should be listed each time a bird is seen which has not previously been entered on the list. Books can be consulted for assistance in identification. This project can be extended over the entire school year. The teacher may employ this list to develop number activities such as counting the number of different birds seen by a child, counting the number of different birds seen by all members of the class, determining the month when the most new birds were sighted, determining the month when the fewest new birds were sighted, comparing lists, determining averages, etc.

4. How can an insect population be determined and studied?

Place a pile of weeds, leaves, etc. gathered from a particular spot in the woods or a field into the top of a large funnel. Put a jar beneath the funnel and a light bulb above it. Insects, worms, etc. will tend to move away from the bright light and fall down into the jar. There is now the opportunity to use books for identifying the living creatures, recording observations on a list or chart, counting the number of each type of creature found, measuring, totaling, comparing, observing, etc.

5. How do different types of animals get their food?

Through observation of animals in captivity in the classroom or those in the field, have the children observe the feeding habits of different animals. A toad eating an insect, a praying mantis eating an insect, a catepillar eating a leaf, a fly eating sugar, or a spider capturing a fly are but a few which would be of interest to the children.

6. How do animals bear and care for their young?

Obtain a male and female pair of white rats or hampsters and keep them in a cage in the classroom. Observe them carefully as the female becomes pregnant, as the young are born, and as the young are cared for.

Some schools may have access to a simple incubator which can be used to hatch a chicken's egg.

7. How do some insects spend their resting stage?

Have the children collect cocoons and bring them to school. What things do they have in common? How do they differ from one another? If you want, the cocoons can be cut open to examine the contents. Some can be kept to see if anything emerges.

8. What animals are suitable for pets?

Plan for a pet day. Have the children bring their pets or, if this is not possible, have them bring pictures of their pets. Devote the day to correlating all activities with the pets. Reading, writing, arithmetic, art, music, and all other subjects can relate to the pets.

9. How do bird nests vary?

Have the children collect abandoned bird nests and bring them to school for comparison and exhibit.

Recent Books

Level

C Baranowski, Richard. INSECTS. Golden Press. New York. 1964. $3.95.
C Bendick, Jeanne. THE FIRST BOOK OF FISHES. Watts. New York. 1965. $2.65.
B Bridges, William. LION ISLAND. Morrow. New York. 1965. $3.25.
B Burger, Carl. ALL ABOUT ELEPHANTS. Random. New York. 1965. $1.95.
C Burgess, Thornton W. THE BURGESS BOOK OF NATURE LORE. Little, Brown. Boston. 1965. $5.00.
B Clark, Ann. BEAR CUB. Viking. New York. 1965.
C Crosby, Alexander L. JUNIOR SCIENCE BOOK OF POND LIFE. Garrard. Champaign. 1964. $2.50.
C Earle, Olive L. BIRDS AND THEIR BEAKS. Morrow. New York. 1965. $2.75.
B Green, Margaret (ed.). THE BIG BOOK OF WILD ANIMALS. Franklin Watts. New York. 1964. $4.95.
C Hopf, Alice L. MONARCH BUTTERFLIES. Crowell. New York. 1965. $3.75.
B Jacobs, Lon. WONDERS OF AN OCEANARIUM. Golden Gate. San Carlos, California. 1965. $3.75.
B Kohn, Bernice. KOALAS. Prentice-Hall. Englewood Cliffs. 1965. $3.50.
C Laycock, George. NEVER PET A PORCUPINE. W. W. Norton. New York. 1965. $3.50.
C Mason, George F. ANIMAL TEETH. Morrow. New York. 1965. $2.75.
C McClung, Robert M. CATEPILLARS AND HOW THEY LIVE. Morrow. New York. 1965. $2.75.
B McClung, Robert. HONKER: THE STORY OF A WILD GOOSE. Morrow. New York. 1965. $2.75.
C Murphy, Robert. THE GOLDEN EAGLE. Dutton. New York. 1965. $3.95.
B Portal, Colette. THE LIFE OF A QUEEN (ANTS). Venturex. New York. 1964. $2.95.
B Ravielli, Anthony. ELEPHANTS, THE LAST OF THE LAND GIANTS. Parents' Magazine Press, New York. 1965. $3.50.
C Selsam, Millicent. ANIMALS AS PARENTS. Morrow. New York. 1965. $2.95.

Teacher References

1. Sourcebook, Chapters 2, 3, 4, and 5.
2. NSTA, Volume 1, Living Things.
3. UNESCO, Chapter IV.

Free Films

1. Dinosaur Hunting Today, 12 min., Canadian Travel Film Library.
2. Expedition Borneo (Monkey), 20 min., Copley Productions.
3. Gooney Birds, 25 min., Evinrude Motors.
4. How to Collect Insects, 13 min., Illinois Natural History Survey.
5. Linnaeus (Classification), 18 min., Swedish Film Center.
6. Newfoundland Sea Birds, 13 min., Canadian Travel Film Library.
7. Our Feathered Friends, 16 min., Information Service of India.
8. Prairie World of the Kit Fox, 21 min., Thomas J. Barbre Productions, Inc.
9. The Rival World (Insects), 25 min., Shell Oil Company.
10. Salmon-Catch to Can, 14 min., Fish and Wildlife Service.
11. The San Diego Zoo, 26 min., Copley Productions.
12. The Smithsonian Whale, 15 min., Smithsonian Museum Service.
13. Sponge, Treasure of the Sea, 14 min., Fish and Wildlife Service.
14. A Summer Day in Sweden (Birds and Animals), 20 min., Swedish Film Center.
15. Underwater Adventure (Deep Sea Life), 12 min., Marineland Center of Florida.
16. The Whooping Crane, 14 min., Bureau of Sport Fisheries and Wildlife.
17. Wildlife World, 30 min., New Mexico Department of Development, Sante Fe Film Bureau.
18. World of Insects, 22 min., California Chemical Center.
19. Your Window in the Sea (Deep Sea Animals), 14 min., Marineland of Florida.

EXPLORATION VIII

HOW DO OBJECTS DIFFER FROM ONE ANOTHER?

Purpose

The purpose of this lesson is to develop an understanding of how differences between objects can be described in terms of physical properties.

Main Ideas

1. There are distinct differences between living and non-living things.
2. Objects can be identified and distinguished from one another by means of distinct properties.
3. Physical properties of matter include such things as shape, color, luster, odor, taste, texture, and hardness.

Television Presentation

Several opportunities will be given for the children to distinguish between objects on the basis of physical properties. From observations of these objects on the television screen, the children will be given an opportunity to tell their teachers what the objects are and what physical properties are useful in identifying them.

Jumping Off Point

Having established the concept of variation in physical properties, the children will be challenged to apply this concept to the process of distinguishing between inaminate objects around them.

Related Activities

1. What materials are used in making the objects around us?

Have the children list the materials which are used in making the things they see around them. The list should include such things as wood, glass, plastic, metal, etc. Then have them list under each of these materials things which they know about which are made of the material. The teacher can take advantage of this opportunity to work with words and allow the children to look through books and magazines in order to get ideas.

2. What are physical properties?

Display a wide variety of objects and substances for the children to look at. Ask them to identify some of them. Following identification of several objects, ask how it is possible to tell what a particular object is. By asking this question relative to a variety of objects, it should soon be obvious that they are identified by their physical properties. It should also be possible, after a brief time, to begin to list what some of these properties are.

3. How can taste be used to distinguish between substances?

Show the children two small piles, one of which is salt and the other sugar. Ask them to determine which is which. Since most of their physical properties are the same, the one which will definitely distinguish between the two substances is taste. Allow the children to guess which is sugar and which is salt until someone suggests and carries out an experiment.

4. How can you distinguish between two objects by means of color?
Blindfold a child and hand him a red and a green crayon from a new box. Ask him if he can detect any difference between the two crayons. To the blindfolded child they will be identical in all physical properties which he can detect. However, to his classmates, the difference will be obvious.

5. How can you distinguish between two substances by their odor?
Put an onion in one box and an apple in another. Ask the children to determine which is which. Naturally, the odor will be the most distinguishing feature.

6. How can you distinguish between two substances by their luster?
The metallic content of twenty-five cent coins has recently been changed. Show the children several quarters and let them separate them according to their metallic content by making use of their luster.

7. How can you distinguish between metals with a magnet?
Divide the class into groups and give each group a magnet. Allow them to move around the room and list all of the metal objects which are attracted to a magnet and those which are not.

8. How can objects be compared in hardness?
Give each child a nail, a penny, and a piece of chalk and ask them to rate the nail, penny, chalk, and their fingernail in order of hardness. The test, of course, is to see which ones are hard enough to scratch the others.

Recent Books

Level

C Bronowski, J. and M. Selsam. BIOGRAPHY OF AN ATOM. Harper and Row. New York. 1965. $2.95.

C Roberson, Paul. CHEMISTRY BY EXPERIMENT. John Day. New York. 1965. $2.50.

Teacher References

1. Sourcebook, Chapters 11 and 12.
2. NSTA, Volume 3, Atoms and Molecules.
3. UNESCO, Appendices C and E.

Free Films

None

EXPLORATION IX

WHAT ARE ALL MATERIALS MADE OF?

Purpose

The purpose of this lesson is to develop the understanding that all substances are made up of basic elements (about 103) and that these elements are made up of tiny particles (molecules and atoms) which are constantly in motion.

Main Ideas

1. All matter is made up of one or more of the 103 basic chemical elements.
2. The basic unit of matter is an atom.
3. A molecule is a combination of two or more atoms.

Television Presentation

By means of a series of analogies, the idea will be established that basic building blocks can be used to form a wide variety of products. This idea will be extended to the concept that a relatively small number of elements can join together in numerous combinations to form virtually a countless number of compounds which make up our earth and which we use in our daily lives. The formation of compounds from elements, the properties of particular elements, and the concept of the particle nature of matter will also be presented.

Jumping Off Point

Having introduced the ideas of basic building blocks, molecules, atoms, and molecular motion, the children will be asked to observe and experiment with additional models and evidence.

Related Activities

1. What evidence do we have that objects are made of tiny particles?

Confront the children with the above question. Then suggest such phenomena as wearing away of a doorknob, wearing of paths, evaporation of water, and others which take place a particle at a time. Discuss.

2. What is the smallest particle of matter?

Take a piece of clay. Carefully cut it in half. Then, take half and cut it in half. Continue with this process until you have reduced it to as tiny a piece as you can cut. Then pose a question to the children concerning what they believe would happen if you could continue to cut the piece of clay. Develop the idea that eventually you would reduce it in size until it could be reduced no longer. You would then have reached the smallest size particle possible for that material, namely, an atom.

3. What evidence do we have that matter is made up of tiny particles?

Allow the children to examine some sugar and a glass of water carefully. Then pour the sugar into the water and stir. What happens to the sugar? Lead the children to see that it must divide into tiny particles which cannot be seen. Tasting the water will allow them to confirm that the sugar is in it.

4. How can the idea of basic elements forming many substances be illustrated?

Use blocks, tinker toys, an erector set, or the analogy of writing a symphony from a musical scale to illustrate the idea of basic elements producing many things.

5. How can scientists learn about atoms even though they cannot see them?

Repeat Related Activity #1 under Exploration I. Point out that just as one can learn about the contents of the box without seeing it, so, also, scientists can learn about atoms without seeing them.

6. What are some of the common chemical elements and how are they used?

Either have the children look up or else tell them the names of some of the most common chemical elements. List under each one some of the ways in which it is used.

Recent Books

Level

C Bronowski, J. and M. Selsam. BIOGRAPHY OF AN ATOM. Harper and Row. New York. 1965. $2.95.

Teacher References

1. Sourcebook, Chapter 12.
2. NSTA, Volume 3, Atoms and Molecules.
3. UNESCO, Appendix C.

Free Films

None

EXPLORATION X

WHAT FORMS DOES MATTER TAKE?

Purpose

The purpose of this lesson is to develop an awareness of the existence of the three states of matter and the relationship of heat to these states of matter.

Main Ideas

1. Matter is something that has weight and occupies space.
2. Matter can exist as a solid, a liquid, and a gas.
3. Matter can change from one form to another.
4. The state of matter of a substance can be changed by adding or taking away heat.

Television Presentation

Using water as an example, the solid, liquid, and gaseous forms of matter will be illustrated and discussed. The fact that a gas has weight and takes up space will be demonstrated with time allowed for the children to suggest to their teachers the conclusions which they draw from their observations. The role of heat in the change of state will be demonstrated. Suggestions will be given for experiments which the children can perform relative to the states of matter.

Jumping Off Point

Using this background information on the three states of matter, the children can now make observations and perform experiments to broaden their concept of matter and its forms.

Related Activities

1. How are heat and the states of matter related?

Put some ice cubes in a pan. Heat and continue to heat until the pan is empty. Describe and explain what happened.

2. How does matter change from one form to another?

Boil some water in a teakettle. Put some ice in a pan and hold the pan over the spout of the kettle. Observe what happens. Explain.

3. Is air really matter?

Turn a water glass upside down and dip it into a pan of water. What happens? If you are not sure whether water goes up into the glass, put a dry handkerchief into the class before immersing it. What happens? Explain.

4. Is air really matter?

Have the children weigh a football or some other ball with and without air in it. Have them determine two ways in which the air makes a difference to the ball. Is air really a form of matter?

5. Do all substances exist in three states of matter?

If possible, obtain a piece of dry ice. Allow it to sit out in the classroom and observe it from time to time. What happens to it? Have the children suggest why they think it is called dry ice.

6. Do all substances exist in three states of matter?

Put a few crystals of iodine in the bottom of a flask. Heat carefully. Allow the children to observe and explain. Be careful not to breathe the vapors.

7. How does heat affect the changing of a liquid to a gas?

Have each child moisten his finger and blow on it. What do they notice about the temperature of the finger where evaporation is taking place? What conclusions can be reached from this?

Recent Books

Level

C Burt, Olive. THE FIRST BOOK OF SALT. Watts. New York. 1965. $2.65.

C Feravolo, Rocco. JUNIOR SCIENCE BOOK OF WATER EXPERIMENTS. Garrard. Champaign. 1965.

Teacher References

1. Sourcebook, Chapters 11 and 12.
2. NSTA, Volume 1, Atoms and Molecules.
3. UNESCO, Chapter IX.

Free Films

None

EXPLORATION XI

HOW DO DIFFERENT MATERIALS BEHAVE WHEN THEY COME INTO CONTACT WITH ONE ANOTHER?

Purpose

The purpose of this presentation is to provide the children with an awareness of how substances can react with one another to cause changes in themselves and to produce new substances.

Main Ideas

1. Different materials can be caused to change and form new substances when they contact or combine with one another.
2. Changes in materials as a result of contact with other materials can sometimes be harmful.
3. Changes in materials as a result of contact with other materials can sometimes be beneficial.

Television Presentation

The idea of chemical reactions to form new compounds will be presented primarily through demonstrations of oxidation. The requirements of fuel, kindling temperature, and oxygen to produce fire will be demonstrated individually with time allowed for the children to express to their teachers the conclusions that they draw from the demonstrations. The fact that the size of a particle affects the speed of burning will be illustrated through several demonstrations. The children will be left with the suggestion that they discuss the ways in which chemical reactions are sometimes helpful and sometimes harmful.

Jumping Off Point

Having been introduced to the idea of chemical reactions, the children will be challenged to observe examples all around them and to experiment with some of these reactions.

Related Activities

1. What is a chemical change?

Put a small amount of water in a jar. Stand an iron nail in the jar so it is partly in and partly out of the water, and put the lid on the jar. Observe the nail each day and record and explain any changes.

Try the same experiment with an aluminum nail and a coated nail. What is the difference? Explain.

2. What is a chemical change?

Place about a teaspoonful of baking soda in the bottom of a water glass. Pour some vinegar on the baking soda. What happens? One test of the results is to hold the flame of a lighted match in the glass. What happens? Describe and explain everything you see.

3. How can you detect a substance with a chemical reaction?

Put a small amount of baking soda, powdered starch, and powdered sugar in three different dishes. Place a few drops of iodine solution on each one. What distinguishing feature identified the starch? How can starch be identified in some foods? (Iodine is poisonous. Care should be exercised in handling it.)

4. How can acids be detected with an indicator?

Obtain from the high school chemistry teacher several pieces of blue litmus paper. Blue litmus paper will turn red in the presence of an acid. Have the children test foods, medicines, cleaning solutions, and other liquids and solutions to determine which ones are part of the large group of compounds called acids.

5. How can bases be detected with an indicator?

Obtain from the high school chemistry teacher several pieces of red litmus paper. Red litmus paper will turn blue in the presence of a base. Have the children test foods, medicines, cleaning solutions, and other liquids and solutions to determine which ones are part of the large group of compounds called bases.

6. How is air important in helping things to burn?

Line up four identical candles. On a given signal, have the children cover one candle with a pint jar, another candle with a quart jar, another candle with a gallon jar, and leave the fourth candle uncovered. Observe and explain the results.

You may want to repeat the experiment and record the lengths of time that the candles remain burning. An effort can be made to attempt to find relationships between the jar sizes and the burning times.

7. How do things differ in their readiness to burn?

Have a child write his name on a piece of paper using vinegar instead of ink. After the vinegar dries, have the child hold the paper a few inches above a candle flame and he will see his name appear on the paper. Explain.

8. Why do bleaches make clothes whiter?

Darken a glass of water with a few drops of soluble ink. Add a few drops of bleach and stir. Explain the results.

9. What is sugar made of?

Put a small amount of sugar into a test tube and heat it over a candle. Observe the results. Have the children try to determine what sugar is made of. They should notice the carbon which forms inside of the test tube and the water which collects on the walls of the tube.

10. How can milk change chemically and how can this change be prevented?

Have the children pour a small amount of milk into two glasses. Put one glass in a refrigerator and leave the other in a warm place. Observe both glasses frequently over a period of a few days. What change is seen taking place? How could it be prevented?

11. What chemical changes commonly take place and how do they affect us?

Have the children observe their surroundings to determine what types of chemical reactions take place, how they affect us, whether they are helpful or harmful, and whether steps are taken to prevent them.

Recent Books

Level

C Burt, Olive. THE FIRST BOOK OF SALT. Watts. New York. 1965. $2.65.

C Feravolo, R. JUNIOR SCIENCE BOOK OF WATER EXPERIMENTS. Garrard. Champaign. 1965.

C Roberson, Paul. CHEMISTRY BY EXPERIMENT. John Day. New York. 1965. $2.50.

Teacher References

1. Sourcebook, Chapter 12.
2. NSTA, Volume 3, Atoms and Molecules.
3. UNESCO, Chapter XII (K).

Free Films

None

EXPLORATION XII

WHAT CAN WE LEARN ABOUT MOVING THINGS?

Purpose

The purpose of this lesson is to make the children aware of motion and the general factors which produce and affect it.

Main Ideas

1. There is motion going on all around us.
2. Motion is produced as a result of a force on an object.
3. Motion is described in terms of speed.
4. Changes in motion are described as acceleration.

Television Presentation

Following examples of the importance of motion, the need for a force to produce motion will be illustrated. The concepts of speed and acceleration will be introduced. Exercises will be provided during which the children become actively involved in judging relative speeds of motion.

Jumping Off Point

Having been made aware of the ideas of speed and acceleration, the children will be asked to observe these phenomena in their surroundings. In addition to observations of things which happen around them, experiments and measurements are encouraged.

Related Activities

1. Why is motion important?

Have the children look around the classroom and list things which must move or be moved in order to be of use. For example, movie projectors and record players will move themselves. However, the switches for both of these devices must be moved as must a pencil sharpener, a pencil, the pages of a book, and a piece of chalk.

2. What produces motion?

Ask the children to examine the objects around them that move and determine what causes the motion. In each case they should find that some sort of force must be applied. Have them list some of the things (electric motors, gasoline engines, wind, themselves, etc.) which apply these forces.

3. What is speed?

Take the class out to the school playground. Have two of the boys race across a set distance. Ask the children which boy ran with the greater speed? How do they know? Ask the children to describe how fast each boy ran. Eventually, they should broaden their concept of speed to describe it in terms of distance and time.

4. What is acceleration?

Take the class to the school playground and have the children watch while you demonstrate acceleration with one boy. Tell the boy that as you start counting, he should begin moving slowly and gradually increase his speed so that by the time you count to five, he should be running at top speed. Then call him back and this time have him take until the count of ten to reach full speed. Have the children discuss the differences in these two examples of increasing speed and develop a concept of acceleration.

5. How is speed measured?

Have the children investigate the ways in which speed is measured. The extent to which they can go in this activity is limited only to their own sophistication. Perhaps the simplest discussions can center around an automobile speedometer. Once they have discovered that this instrument measures speed in miles per hour, an effort can be made to interpret this to them. For example, if a particular town which they are all familiar with is 40 miles away, then you can discuss how it takes one hour to get there if your car travels at 40 miles an hour.

This activity can be expanded to using maps, discussing the high speeds of airplanes, the need for very high speeds in space flight, the use of other units such as the knot, etc.

6. How fast do various transportation vehicles travel?

Have the children either draw or cut from magazines as many examples of transportation as they can find. These can range from a person walking, to a rocket speeding into space. Arrange these pictures on a chart or bulletin board in order of speed of motion. If possible, have the children consult books or inquire concerning the approximate speed of each of these methods. These numbers can be included in the display. The opportunity for number work may present itself during this activity.

7. How can speed be measured?

Take the children to the school playground and line them up for a type of race. Tell them that when you say "go" they are to move forward by bringing the heel of one shoe to the toe of the other shoe. They are to continue moving forward in this manner as you time them for one minute at which time you will tell them to stop. As they move forward they are to count the number of "steps" they take.

Time them moving forward for one minute and then have them compare their speeds in "steps per minute". If it does not confuse them, the possibility also exists of introducing the idea that the steps are of different lengths and therefore, in one respect, are not units which can be used for comparison.

Recent Books

Level

C Mark, Steven. A PHYSICS LAB OF YOUR OWN. Houghton Mifflin. Boston. 1964. $3.00.

B Milgrom, Harry. ADVENTURES WITH A BALL: FIRST SCIENCE EXPERIMENTS. Dutton. New York. 1965.

B Milgrom, Harry. ADVENTURES WITH A STRING: FIRST SCIENCE EXPERIMENTS. Dutton. New York. 1965.

Teacher References

1. Sourcebook, Chapters 25 and 26.
2. NSTA, Volume 4, Motion.
3. UNESCO, Chapters X and XI.

Free Films

None

EXPLORATION XIII

WHAT ARE SOME OF THE THINGS WHICH CAUSE MOTION?

Purpose

The purpose of this lesson is to acquaint the children with some of the forces which affect objects and cause motion.

Main Ideas

1. Motion is produced by a force acting upon an object.
2. Forces which produce motion come from a variety of sources.
3. Gravity is an important natural force which can cause motion.

Television Presentation

Special attention will be given to the forces which cause motion. Sources of these forces such as our bodies, forces in nature, and the conversion of other types of energy into motion will be explored. Several demonstrations of motion will be shown and an opportunity provided for the children to explain these demonstrations to their teachers.

Jumping Off Point

Following this introduction, the stage will be set for the children to make related observations in their own environments and to carry out experiments to help them learn more about forces around them.

Related Activities

1. How does the size of a force acting on an object affect its motion?

Tie one end of a piece of string on the front of a roller skate and tie a small stone on the other end. Allow the stone to dangle over the edge of a table and release the roller skate. Observe what happens. Next, replace the stone with a heavier one and repeat the experiment. Continue the experiment using successively heavier stones. What conclusions can you draw about the above question?

2. Does the weight of an object have anything to do with how the force of gravity affects its motion?

Obtain two stones. Use one about the size of a golf ball and one about the size of a baseball. Ask the children which one they think would fall faster. How could they find out? Let them plan an experiment such as dropping the two stones simultaneously from a second story window. What conclusions can be drawn?

3. What are some of the sources of forces which cause motion?

Have the children list things which exert forces that produce motion. Prepare a chart or bulletin board using each of these suggestions as a topic and illustrate it with pictures from magazines or drawings.

4. How is force related to the speed and the acceleration of an object?

Take your class to the playground. Give one of the boys a baseball and ask him to throw it straight ahead of him so that it will land at a mark about ten feet in front of him. Repeat the demonstration only this time make it twenty feet in front of him. Continue to repeat it making the distance longer each time. What is necessary to increase the acceleration and speed of the ball?

5. At what place on an object does the force of gravity seem to act?

Use a sharpened pencil with a flat end (no eraser). Lay the pencil flat on the desk. Begin to slide one end of the pencil off the edge of a desk until the pencil tips and begins to fall. Mark the position of the pencil that was at the edge of the desk when it started to fall. Now, turn the pencil around and begin to move the other end off the edge of the desk until it begins to fall. Again, mark the place on the pencil which is at the edge of the desk when it started falling. On a level desk try balancing the pencil on its point and then try balancing it on the flat end. Is there a place in the pencil where the pull of gravity seems to act?

6. How does the slope of a hill affect the speed of an object which is rolling down?

Prop one end of a three foot board on a book. Place a toy car or a roller skate on the raised end and record the time required for it to roll down the board. Repeat the experiment using an additional book for propping each time. What conclusions can you draw?

Recent Books

Level

C Mark, Steven. A PHYSICS LAB OF YOUR OWN. Houghton Mifflin. Boston. 1964. $3.00.
B Milgrom, Harry. ADVENTURES WITH A BALL: FIRST SCIENCE EXPERIMENTS. Dutton. New York. 1965.
B Milgrom, Harry. ADVENTURES WITH A STRING: FIRST SCIENCE EXPERIMENTS. Dutton. New York. 1965.
C Roberson, Paul. ENGINES. John Day. New York. 1965. $2.50.

Teacher References

1. Sourcebook, Chapters 25 and 26.
2. NSTA, Volume 4, Motion.
3. UNESCO, Chapters X and XI.

Free Films

1. ABC of Automobile Engines, 21 min., General Motors Corporation.
2. ABC of Jet Propulsion, 17 min., General Motors Corporation.
3. ABC of the Diesel Engine, 20 min., General Motors Corporation.

EXPLORATION XIV

WHAT ARE SOME OF THE THINGS WHICH TEND TO KEEP OBJECTS FROM MOVING?

Purpose

The purpose of this lesson is to make the children aware that, as certain forces are acting to cause objects to move, other forces are acting to resist movement.

Main Ideas

1. The action of friction tends to resist and slow down motion.
2. Inertia is a significant factor in resisting motion.
3. Gravity is a force which resists motion away from the earth.

Television Presentation

Emphasis will be placed upon the role which friction, inertia, and gravity play in keeping things from moving. The children will be shown examples of each of these factors and will be asked to identify them through discussions with their teachers.

Jumping Off Point

Having been introduced to the ideas of resistance to motion due to friction, inertia, and gravity, the way will be paved for the observation of additional examples and experimentation to provide a better understanding of these factors.

Related Activities

1. Why are wheels important for moving things?

Tie a string around a stack of three books and, by pulling the string, slide the books across a table. Next, put several round pencils under and in the path of the books and again, by pulling the string, slide them along the table. Explain the difference in the effort required.

2. How much does gravity resist motion?

Tie a string on the front of a roller skate or a toy car. Attach a weight of some kind to the skate or car. Using a spring balance to measure the pull on the string, draw the skate along a three foot board and record the force required. Next, place one book under one end of the board and measure the force needed to pull the skate up the incline. Repeat the experiment several times using additional books to increase the slope of the incline and each time record the force required to pull the skate. Finally, record the weight of the skate and attached weight by lifting it straight up with the spring balance. What conclusions can the children draw from this experiment?

The opportunity is available for several number activities including the preparation of a simple graph which indicates the relationship between the number of books and the force required.

3. What materials provide the greatest friction?

Place a block of wood on a board which is about two or three feet long. Raise one end of the board slowly until the block begins to slide. Carefully measure and record the height at which sliding began. Attach various types of surfaces on the block of wood where it comes into contact with the board. This can be done in a variety of ways. A few dabs of rubber cement is one possibility. Such materials as sandpaper, cloth, rubber, etc. make good experimental surfaces. Repeat the experiment and record the height which the board is raised for each one. What conclusions can be drawn?

4. How is friction used to stop a car?

Arrange for one of the teachers or a mechanic from a nearby garage or gas station to remove the wheel from a car and demonstrate how friction is used in the brake mechanism for stopping a car.

5. How does inertia act to resist motion?

Stack four or five books on a pile. Grasp the one on the bottom and pull it out quickly without upsetting the pile or moving it forward. Why is this possible?

6. How does inertia act to resist motion?

Lay a cotton or linen towel on a table with the end of the towel hanging over the side of the table. Place a few dishes on the towel. With a quick downward jerk, remove the towel without disturbing the dishes. Why is this possible?

7. How does inertia act to resist motion?

Locate two stones about the size of a softball and hang them from a tree limb or some sort of cross bar using string which is just strong enough to hold them. Allow an extra length of string to dangle below the stones. Ask your students what they think would happen if you pulled on the bottom string. Would the string break above or below the rock? Show them that if it is pulled down with a steady pull, the string breaks above the rock. If it is pulled with a sudden, quick jerk it will break below the rock. Have the children explain.

8. How does inertia act to resist motion?

Balance a card on your finger with a coin on top of it directly above the finger. Using your other hand, flick the card from your finger in such a way that the coin remains. Have the children try it and explain.

9. How does inertia act to resist motion?

Have the children stack about four or five pennies in a pile. Using another penny near the base of the pile, flick it toward the pile with your finger and observe what happens. Explain.

10. How does inertia act to resist motion?

Balance a card on the top of a soft drink bottle with a marble on top of it directly above the top of the bottle. Flick the card away with your finger in such a way as to cause the marble to drop into the bottle. Why is this possible? Explain.

Recent Books

Level

C Mark, Steven. A PHYSICS LAB OF YOUR OWN. Houghton Mifflin. Boston. 1964. $3.00.

Teacher References

1. Sourcebook, Chapter 25.
2. NSTA, Volume 4, Motion.
3. UNESCO, Chapters X and XI.

Free Films

None

EXPLORATION XV

WHAT ARE SOME TYPES OF ENERGY AND HOW DO WE USE THEM?

Purpose

The purpose of this lesson is to acquaint the children with the wide variety of forms of energy and how these various forms of energy work for us.

Main Ideas

1. Heat, electrical, atomic, light, sound, chemical, and mechanical energy are all important to us in our daily lives.
2. Energy can be changed from one form to another.

Television Presentation

Through a contrast with the past when energy was not harnessed as it is today, the importance of energy to do work will be emphasized. Various types of energy will be introduced in the form of animated characters and their characteristics described. An opportunity will be provided for the children to participate in an experiment during the television lesson. Time will be set aside for the children to identify forms of energy represented in a series of pictures.

Jumping Off Point

Having become acquainted with energy and the various forms of energy, the children will be asked to explore their surroundings to discover the many applications of energy and the ways in which it is transformed from one form to another.

Related Activities

1. How is energy used?

Have the children prepare a chart or bulletin board by picturing under the title of each form of energy some of its uses and applications. Pictures can be drawn and/or cut from old magazines.

2. How is energy used in our homes?

Have each child explore his own home and either list or report to his class the various types of energy which are used and how they are used.

3. Where is energy changed from one form to another?

Have the children draw or cut from old magazines devices which change energy from one form to another. Then, have them either label or symbolically indicate what kind of energy goes into the device and what kind comes out. For example, an electric iron changes electrical energy into heat energy.

4. Where is energy changed from one form to another?

Have each child explore his own home and either list or report to the class devices which change one form of energy into another.

5. How can mechanical energy be converted into heat energy?
Have the children put the palms of their hands together and rub them vigorously (mechanical energy). Ask them what they feel (heat energy). Discuss.

6. How can mechanical energy be converted into electrical energy?
Have a few children run combs through their hair (mechanical energy) and then try to pick up small pieces of paper with the comb (static electricity). Discuss the conversion of energy.

7. What have scientists learned in recent years about the use of energy?
Have the children ask their parents what devices, which use some form of energy, they presently have in their homes which the parents did not have when they were children. Discuss in class.

Recent Books

Same as for Exploration XIV.

Teacher References

1. Sourcebook, Chapters 15, 16, 17, 18, 22, 24, and 25.
2. NSTA, Volume 4, Motion.
3. UNESCO, Chapters X, XI, XII, XIII, XV, and XVI.

Free Films

None

EXPLORATION XVI

WHAT IS MECHANICAL ENERGY AND HOW DO WE USE IT?

Purpose

The purpose of this lesson is to acquaint the children with mechanical energy so that they can readily recognize it, its applications, and its importance to them.

Main Ideas

1. Mechanical energy is energy of motion.
2. Machines use mechanical energy to do work.

Television Presentation

Using an animated character to represent mechanical energy, the various types of simple machines will be described. Opportunities will be provided for the children to actively participate and respond to questions about what they are shown.

Jumping Off Point

Having gained this background in the nature of mechanical energy and its applications in machines, the way will be paved for the children to explore and become more readily aware of the wide variety of uses made of mechanical energy and machines all around them.

Related Activities

1. What are some of the devices around us which use mechanical energy?

Have the children prepare a chart or bulletin board on machines and mechanical energy. Illustrate it with pictures which are drawn or cut from old magazines.

2. How does a simple lever help in lifting a weight?

Put a stone on one end of a ruler, an eraser under the center of the ruler, and push down with your finger on the other end. The stone will move up. Change the position of the eraser under the ruler from place to place and describe what effect the position of the eraser has on the effort required to raise the stone.

3. How are many basic machines combined in a compound machine?

Have the children examine a machine which combines a variety of basic machines. Have them identify these individual machines and see how they combine to accomplish a particular task. An old clock is an example of the type of thing which can be used if access to a larger machine is not convenient.

4. How do gears change the direction of force and motion?

Have the children nail a few soft drink caps (top down) to a piece of wood in such a way that each one is in contact with another one and the toothlike projections mesh together. Have them turn one of the caps and observe and discuss what happens to the others.

5. How do our bodies make use of simple machines?

Have the children consider the importance of levers (arms, legs, fingers, etc.) in their bodies. Using cardboard and metal fasteners, perhaps some of the children could construct models of the body which would demonstrate these various parts as levers.

6. What general types of things can machines do?

Machines are used to (1) move heavy objects, (2) increase the speed of movement, and (3) change the direction of movement. Have the children prepare a chart on each one of these uses and illustrate it with pictures or a list of machines which accomplish each particular function.

7. How does an inclined plane help to do work?

Have the children weigh a brick with a spring balance. How much force would be required to lift the brick from the floor to a table? Next, lean a board on a slope from the floor to a table and have the children measure the force required to slide the brick up the board. Discuss.

8. How can gears be used to increase speed?

Have one of the children bring a bicycle to class. Turn it over on its seat and handle bars. A large number of observations and experiments can be carried out. For example, as you turn the large gear with the pedal one time, how many times does the small gear turn? How does the number of teeth on the small gear compare with the number on the large gear? How far does the bicycle move forward when the pedals move around one time? Can the children detect any relationships which extend through all of these comparisons?

Recent Books

Same as Exploration XIV.

Teacher References

1. Sourcebook, Chapter 25.
2. NSTA, Volume 4, Motion.
3. UNESCO, Chapters X and XI.

Free Films

None

EXPLORATION XVII

WHAT IS WAVE ENERGY AND HOW DO WE USE IT?

Purpose

The purpose of this lesson is to make the children aware that waves can carry energy and that sound and light have the characteristics of waves.

Main Ideas

1. Energy can move from one place to another by means of wave motion.
2. Sound behaves like a wave.
3. Light behaves like a wave.

Television Presentation

Using an animated character representing wave motion and a series of demonstrations, the wave properties of reflection, refraction, interference, and diffraction will be explained and illustrated.

Jumping Off Point

Having been introduced to sound and light from the point of view of their wave characteristics, the way is paved for the children to make observations and perform experiments which will provide them with a better insight into light and sound and phenomena related to them.

Related Activities

1. How can waves be observed and studied?

Drop a stone into a pond or a tub of water. Have the children observe the waves produced. Notice the up and down motion. Notice how they spread further and further from the source. Float something in the water and notice how it is effected by the waves.

2. How can waves be observed and studied?

Take about 25 feet of clothesline and have a child hold one end while you apply a quick up and down motion to the other end. What happens along the rope? Does the child feel the up and down motion? Continue to experiment using a variety of methods of input including a variation in the speed, intensity, and number of input movements. Observe and discuss your observations.

3. What are the parts of a wave?

Have a child put on a pair of roller skates or stand on a skateboard next to a blackboard. Have the child draw up and down on the blackboard with a piece of chalk. As he does push him forward along the blackboard. The combined horizontal motion of his body and vertical motion of his hand will produce a wave. Label some of the parts of the wave such as a crest, a trough, and a wavelength.

4. How does sound travel through the air by compressional waves?

Have one of the children bring to school a common, springlike toy called a slinky. Have two children take the ends of the slinky and stretch it several feet between them. Then have one of the children press about ten loops of the spring together and suddenly release them. Observe and discuss the results.

5. How do the speeds of sound and light waves compare?

Take the children out to the school playground. Have one child move to one end of the school ground with a hammer and block of wood while the rest of the class moves to the other end of the school ground in a position where they can still see the lone child. Have the child strike the block of wood with his hammer. The rest of the class should watch and listen. From their observations, what can they conclude about the relative speeds of light and sound waves?

6. How fast does light travel?

Stand at one end of a dark room with a flashlight. Point the flashlight toward the opposite wall. As you push the button to turn the light on, watch the wall and estimate how long it takes for the light to reach the wall. Would you say that light travels as fast as you can walk, as fast as you can run, as fast as a car, as fast as an airplane, or faster?

7. How is light bent?

Put a pencil into a glass of water. Look at it from all angles. Do you notice anything of interest? Can you explain it?

8. What causes sound?

Stretch a rubber band about four inches, have someone pluck it in the center, and listen. Stretch it another inch, pluck it, and listen. Continue this process for as long as the rubber band will endure. What causes the sound? Why do the sounds vary?

9. What substances best carry sound?

Obtain a yardstick. Put one end against your ear and have someone scratch the other end. Then, without moving your ear, swing the end of the yardstick away and have the person scratch the other end (still three feet away from your ear) again. What do you notice about the sounds? Can you explain the difference?

10. How do curved mirrors and lenses effect light?

Obtain any available curved mirrors and lenses. Have the children observe and experiment with them and discuss their observations.

Recent Books

Same as Exploration XIV.

Teacher References

1. Sourcebook, Chapters 15, 16, and 23.
2. NSTA, Volume 5, Energy in Waves.
3. UNESCO, Chapters XII, XVI.

Free Films

1. The Magic Box That Remembers (Cameras), 16 min., Eastman Kodak Company.
2. We Learn About the Telephone, 25 min., Bell System Telephone Offices.

EXPLORATION XVIII

WHAT IS HEAT ENERGY AND HOW DOES IT AFFECT THINGS?

Purpose

The purpose of this lesson is to call the children's attention to heat as a form of energy and to make them aware of its importance and many uses in their daily lives.

Main Ideas

1. Heat is a form of energy.
2. The temperature of a substance depends upon the amount of heat which it contains.
3. Most substances expand when heated.
4. Heat can be transferred from one place to another by convection, conduction, and radiation.
5. Heat energy can be harnessed to do many useful tasks.

Television Presentation

Using demonstrations and an animated character to represent heat energy, basic principles of heat and temperature will be introduced. Characteristic temperatures such as the boiling point and freezing point of water will be mentioned. The role of heat in expansion will be demonstrated. Several demonstrations will also be carried out to illustrate heat transfer by radiation, convection, and conduction.

Jumping Off Point

The children are prepared by the television lesson for experiences, observations, and experiments in temperature measurement, expansion due to heat, and heat transfer.

Related Activities

1. How does heat travel by radiation?

Have the children hold their hands a few inches away from a high wattage light bulb. What do they feel? Have them move a sheet of paper in and out between their hands and the bulb. Discuss what is felt and observed.

2. How is radiated heat best absorbed?

Obtain two identical tin cans. Wrap the outside of one with white paper and the other with black paper. Put an equal amount of cool watter (at room temperature) in each and put the cans in the sun. Take the temperature of the water in the cans at regular intervals of time. What is learned from this experiment? How does this affect the choice of clothing in different climates, the color of a roof, the color of space craft, etc.

When this experiment is carried out, a chart can be developed for recording the data, rates of temperature rise can be calculated, differences in temperature can be calculated, changes in temperature can be graphed, and a variety of other number activities can be employed.

3. How does heat affect the space that a gas occupies?

Cut a piece of rubber from a balloon, stretch it over the top of a jar, and secure it tightly with rubber bands around the neck of the jar. Put the jar into a pan of water in such a way that the jar is only partially immersed in the water. Heat the water to boiling on a stove. Observe the rubber top and explain.

4. What effect does heat have on a liquid?

Put a pan of water on the stove and hold a glass of water about eight inches above the open pan for about a minute. Then, put down the glass, turn on the stove, bring the water to a boil, and hold the glass in the same position as before. What happens? Why? How does the water get from the pan to the outside of the glass?

5. How does heat travel by conduction?

Obtain a heavy copper wire about a foot long. Using wax from a burning candle, attach paper clips or thumb tacks at intervals of about two inches along the wire. Hold the wire with a pair of plyers with one end in a candle flame. Observe what happens and explain.

6. How does heat travel by convection?

Sprinkle some light powder or clap two blackboard erasers over a hot radiator. What is observed? Discuss.

7. What substances conduct heat best?

Obtain several objects about one-eighth of an inch thick which are made of different materials. One at a time, place them on a hot radiator and touch the other side. Record the amount of time required for the objects to become too hot to touch. List the substances in the order in which they best conduct heat. Discuss the advantages of materials which conduct heat well and those which conduct heat poorly. CAUTION: Teachers should be careful not to use extremely hot radiators and to avoid any possibility of burns.

8. What devices do we commonly use which employ heat energy?

Have the children prepare a bulletin board showing the uses of heat energy. Indicate the many devices which use heat to do work and assist us in our daily tasks.

9. How does the outside temperature vary during the day and from day to day?

Mount a thermometer outside of the classroom window and, for several days, record the temperature every hour during the school day. A series of graphs would be helpful in picturing temperature variations and trends. What conclusions can be drawn from the data collected?

10. How does heat affect the length of things?

Extend a wire between two firm supports on a table. Hang a weight from the center of the wire and measure its height above the table. Heat the wire with a candle and continue to measure the height of the weight as you do. What happens? Explain.

Recent Books

Level

C Mark, Steven. A PHYSICS LAB OF YOUR OWN. Houghton Mifflin. Boston. 1964. $3.00.

C Roberson, Paul. ENGINES. John Day. New York. 1965. $2.50.

Teacher References

1. Sourcebook, Chapters 17 and 18.
2. NSTA, Volume 5, Energy in Waves.
3. UNESCO, Chapter XIII.

Free Films

1. ABC of Automobile Engines, 21 min., General Motors Corporation.
2. ABC of Internal Combustion, 13 min., General Motors Corporation.
3. ABC of Jet Propulsion, 17 min., General Motors Corporation.
4. ABC of the Diesel Engine, 20 min., General Motors Corporation.

EXPLORATION XIX

HOW DO WE USE ELECTRICAL ENERGY?

Purpose

The purpose of this lesson is to call the children's attention to electricity as a form of energy and to make them aware of its importance and many uses in their daily lives.

Main Ideas

1. Electricity is a form of energy.
2. Static electricity is a type of electricity which can be stored on an object.
3. Current electricity, the kind which flows through wires, is the type which we use in our homes.
4. Electrical energy can be changed into many other kinds of energy and put to useful purposes.

Television Presentation

Using an animated character to represent electrical energy, the distinction will be drawn between static and current electricity. Benjamin Franklin's discovery of the relationship between electricity and lightning will be dramatized. Demonstrations of static and current electricity will be presented along with ways of generating electric current. Uses of electricity and its conversion to other forms of energy will be discussed. Opportunities will be provided for active student participation in the lesson.

Jumping Off Point

Having been introduced to electricity as a form of energy, discussed its uses, seen its applications, distinguished its forms, and discussed its conversion into other forms of energy, a structure has been established upon which to build with other observations and experiences.

Related Activities

1. How can static electricity be produced?

Have the children run a comb through their hair or rub it with a piece of wool. Touch the combs to small pieces of paper. What happens? Explain.

2. How can static electricity be produced?

Have the children blow up balloons and rub them on their hair or on wool. Touch the balloons to small pieces of paper. Rub them again and see if they will stick to the wall. Discuss.

3. How can static electricity be studied?

Hang two pieces of puffed rice cereal beside each other on the end of six inch lengths of silk thread. Charge a comb by rubbing with hair or wool and touch it to the pieces of puffed rice. Continue to experiment. What happens? Discuss.

4. How can static electricity be built up to release a spark?

If there is a carpet available, have the children rub their feet over the carpet and touch one another lightly. If atmospheric conditions are suitable, they should be able to detect sparks being produced.

5. How can static electricity be used to produce light?

Obtain a fluorescent light bulb. Rub it briskly with a piece of wool or flannel in a dark room or closet. What do you observe? Can you explain what happens? If fluorescent bulbs are lighted only by electricity, where is the electricity coming from? Care must be taken not to break the bulb.

6. How can electricity be used to light a bulb?

Obtain a light bulb and a cell from a flashlight. Wrap one end of a short piece of wire around the screwlike base of the bulb. Place the tip of the bulb on the button-like terminal of the cell and touch the loose end of the wire to the other end of the cell. What happens? Why must everything be touching tightly in order for the bulb to go on? Examine the bulb carefully and explain how it works.

7. How can electricity be used to produce a magnet?

Wrap several turns of bell wire around an iron nail or bolt. Connect the ends of the wire to a dry cell and touch the nail to a pile of small nails, paper clips, or thumb tacks. Discuss some of the ways in which magnets of this type are used.

8. What are some ways in which electricity is used?

Have the children prepare a chart or bulletin board on how electricity is used. Illustrations can come from drawings or pictures cut from magazines.

9. What devices convert electricity to other forms of energy?

Have the children prepare a series of charts that illustrate devices which change electricity to other forms of energy. For example, one chart can show things which make light from electricity, another can show devices which produce heat, still another can illustrate devices which produce sound, etc. Words and pictures can be used.

10. How is electricity produced?

Have the children read, explore, and inquire in order to find out as many ways as possible that electricity is produced. This exploration may include cutting and examining the inside of a dry cell, visiting an electricity generating plant, etc.

Recent Books

Same as Exploration XIV.

Teacher References

1. Sourcebook, Chapter 22.
2. NSTA, Volume 5, Energy in Waves.
3. UNESCO, Chapter XV.

Free Films

None

EXPLORATION XX

WHAT CAN WE LEARN ABOUT THE ROCKS AND SOIL WHICH MAKE UP OUR EARTH?

Purpose

The purpose of this lesson is to introduce the children to an awareness of the variety of types of rocks and soils which make up the earth and to provide a stimulation to examine and study them.

Main Ideas

1. There is a wide variety of types of rocks and soils which make up our earth.
2. Rocks form in a variety of ways.
3. Soil is constantly being formed in a variety of ways.

Television Presentation

This lesson will introduce the study of the earth. The interior of the earth will be illustrated. The nature of igneous, sedimentary, and metamorphic rocks will be described. The formation of soil with organic and inorganic matter will be demonstrated. Factors which cause the weathering of rock, resulting in its breaking down into soil, will be shown through the use of film. The importance of conservation to maintaining a productive earth will be stressed.

Jumping Off Point

With the basic background information which is presented, the children should be able, through observation and experimentation, to more intelligently examine the earth around them.

Related Activities

1. How do types of rocks vary?

Have the children collect as many different rocks as possible and bring them to class. Through careful examination, have them classify the rocks in as many ways as possible.

2. What are rocks made up of?

In order to study some of the rocks more carefully, have the children wrap them in heavy cloth and break them with a hammer. Examine the interior structure carefully. A magnifying glass would be helpful. What are some of the features?

3. What is the structure of the earth?

Locate a book in the library which shows the structure of the earth including the crust, mantle, and core. Using clay and tempera paints, make a cross section model of the earth.

4. How can rocks and minerals be identified?

Gather samples of rocks and minerals which can be found in your community. Search in the library for books which will assist you in identifying them.

5. How can rocks be classified according to hardness?

Locate around the neighborhood as many different stones as possible. Group them according to which ones can be scratched with your fingernail (softest), ones which can be scratched with a penny (next to softest), ones which can be scratched with a knife blade(harder), and ones which can scratch glass (hardest).

6. How can limestone be easily identified?

Put a piece of limestone and three rocks which do not contain limestone individually into four separate dishes. Pour vinegar on each rock. What happens? What is a simple test for limestone?

7. How can temperature changes cause rocks to break down and form soil?

Heat several glass marbles in a frying pan on a hot plate for about five minutes. While still hot, pour them into a pan of cold water. After they have had time to cool, examine them carefully.

8. How can it be determined whether soil is acid or basic?

Collect several soil samples in small jars. Add some rain water or distilled water to them and test with litmus paper to determine whether they are acid or basic.

9. How can soil be examined for coarseness of its makeup?

Pour a soil sample into a jar, filling it about half way. Pour in water bringing the level within about an inch of the top. Shake it vigorously and allow it to settle. Since the coarsest part will settle to the bottom of the jar first and the finest will remain on top, a cross section of the makeup of the soil can be viewed through the side.

10. What types of soil can you find in your neighborhood?

Locate a book which will assist you in identifying humus, loam, sandy, gravel, and clay soils. Gather samples from as many sources as you can and label them according to the classification which they most nearly fit.

Recent Books

Level

C Sootin, Harry and Laura. THE YOUNG EXPERIMENTER'S WORKBOOK: TREASURES OF THE EARTH. W. W. Norton. New York. 1965. $3.00.

C Werner, Elsa June. THE GOLDEN GEOGRAPHY. Golden Press. New York. 1964. $3.95.

Teacher References

1. Sourcebook, Chapter 8.
2. NSTA, Volume 2, The Earth.
3. UNESCO, Chapter V.

Free Films

1. Aluminum--Today and Tomorrow, 20 min., Kaiser Aluminum and Chemical Corp.
2. Asbestos - A Matter of Time, 22 min., Bureau of Mines.
3. Barrel Number One, 29 min., American Petroleum Institute.
4. Copper, The Oldest Known Metal, 27 min., Bureau of Mines.
5. The Fossil Story, 19 min., Shell Oil Company.
6. It Never Rains Oil, 15 min., Texaco, Inc.
7. The Magic of Sulfur, 26 min., Bureau of Mines.
8. Story in the Rocks (Fossils), 19 min., Shell Oil Company.
9. White Wonder (Salt), 28 min., Modern Talking Pictures Service.

EXPLORATION XXI

WHAT CAN WE LEARN ABOUT THE LOCATION AND IMPORTANCE OF WATER ON THE EARTH?

Purpose

The purpose of this lesson is to focus the children's attention on the variety of places where water occurs on the earth, its importance to us, and the need for using it wisely.

Main Ideas

1. Water exists on the earth in solid, liquid, and gaseous forms.
2. Water exists on and below the surface of the earth.
3. Water exists on the earth in the form of oceans, lakes, rivers, streams, etc.
4. Our sources of water must be protected from pollution.

Television Presentation

The children will be shown a variety of forms in which water appears on the earth and will be asked to identify them. Two or three different interpretations may be given to a particular scene but this is unimportant. The important thing is that a wide variety of bodies of water be named. The existence of water as a solid, liquid, and gas will be demonstrated along with a suggestion of an experiment which the children can do. The formation and precipitation of rain will be described. The chemical composition of water will be touched upon briefly. After having the children discuss what they would do without water, the importance of water conservation will be stressed.

Jumping Off Point

Having received a broad view of the earth's water resources, the children can proceed to examine water resources in their own area and investigate water pollution and water conservation.

Related Activities

1. How much of the earth's surface is covered with water?

Using a globe, estimate the percentage of the earth's surface that is covered by water. Have each child in the class make his own estimate and average them. Average the estimates and see if a published estimate can be located for purposes of comparison (about 71%).

2. Where can water be found?

Have the children prepare a bulletin board which illustrates all of the places where water can be found. It should, of course, include bodies of water, but should also include anything which they can think of which contains water.

3. How much water do our foods contain?

Have the children bring to school samples of several different foods. Have them develop ways to determine the amount of water in each kind of food. This could be done by weighing, drying and reweighing, measuring shrinkage, etc.

4. What are our sources of drinking water?

Have each child in the class find out and report on his source of water at home. Some may get water from a city system, but others might use wells, springs, etc.

5. How does a city provide water to a large number of people?
If possible, arrange for the class to visit a city water purification plant. Learn what the sources are and how the water is purified for drinking.

6. How pure is the water in your vicinity?
Have the children bring samples of water from a variety of sources. Put equal amounts in each of several test tubes and boil the water away. The residue left in the test tube should give some indication of the purity of the various water sources.

7. How pure is the water in your vicinity?
Have the children bring samples of water from many sources. If a microscope is available, examine the water to determine the presence of any living organisms.

8. What are the uses of water ways and bodies of water?
Have the children prepare a bulletin board on the uses of water. It should include such factors as food, transportation, recreation, etc.

9. How does fresh water differ from salt water?
Have the children suggest experiments which they can carry out to determine the differences between salt water and fresh water.

Recent Books

Level
- B Evans, Eva Knox. THE SNOW BOOK. Little, Brown. Boston. 1965. $3.25.
- C Feravolo, R. JUNIOR SCIENCE BOOK OF WATER EXPERIMENTS. Garrard. Champaign. 1965.
- C Snyder, Dick. THE TRIESTE: THE STORY OF THE U.S. NAVY'S FIRST INNER SPACE SHIP. Golden Gate. San Carlos, California. 1964. $3.50.
- C Werner, Elsa. THE GOLDEN GEOGRAPHY. Golden Press. New York. 1964. $3.95.

Teacher References
1. Sourcebook, Chapter 8.
2. NSTA, Volume 2, The Earth.
3. UNESCO, Chapter IX.

Free Films

The Restless Sea, 60 min., Bell System Telephone Offices.

EXPLORATION XXII

WHAT CAUSES CHANGES IN THE EARTH'S SURFACE?

Purpose

The purpose of this lesson is to make the children aware of the fact that the surface of the earth is constantly changing and to give them an awareness of the factors which contribute to this change.

Main Ideas

1. The surface of the earth is constantly changing.
2. A wide variety of factors act upon the earth's surface to cause changes to take place.

Television Presentation

This lesson will consist of a series of demonstrations of factors which cause changes in the surface of the earth. After each demonstration, time will be provided to allow the children to suggest ways in which that particular factor could alter the surface of the earth. A picture of actual effects will then be shown. Factors which will be demonstrated include earthquakes, folding, volcanoes, rainfall, running water, winds, oceans, glaciers, and chemical reactions.

Jumping Off Point

Having been made aware of the changing earth's surface and the methods of these changes, the opportunity is available for the children to examine their own surroundings for evidence of such changes.

Related Activities

1. What changes take place in the earth's surface around us every day?

Mark off a small plot of ground a few feet square on the school grounds. Clear it of any plants and rake it smooth and flat. Examine it periodically particularly after strong winds and rain. Keep a record of changes which take place.

2. How do temperature changes cause changes in the earth?

Heat a small, soft rock, such as sandstone, over a hot flame for several minutes and drop it into a bowl of cold water. What happens? Explain. Discuss its relationship to changes in the earth's surface.

3. How does water affect the earth's surface?

Put some moist soil into an aluminum baking pan. Prop one end up a few inches and punch a hole in the other end to allow water to escape. Place the whole apparatus into a larger baking pan. Each day, pour about half of a cup of water into the soil. Record observations of changes which occur daily.

4. What causes a landslide?

Prepare a pile of dirt about two to three feet high. Squirt water at the base of the pile and observe. Discuss.

5. What are some of the physical features of the earth?

Using sand, soil, clay, plaster of paris, paper mache, etc., prepare a relief model on a table which shows as many features of the earth's surface as possible.

6. How do chemical reactions cause changes on the earth?
Locate a small chip of marble and examine it carefully. Next, boil it in vinegar for five to ten minutes and, again, examine it carefully. Discuss.

7. How do temperature changes cause changes on the earth's surface?
Fill a small jar with water and wrap it carefully with newspapers, cloth, or plastic bags. Use string, rubber bands, or tape to hold the wrapping firmly in place. Put the jar in the freezer overnight. Examine it the next morning. What happened? How does this relate to changes in the earth's surface?

8. How does rainfall cause the earth to change?
When rain drops strike the ground, soil is dislodged and splashes with the rain. The height which it splashes can be measured by attaching a ruler vertically to a firm support. Following a rainfall, check to see how high the dirt splashed. Wipe the ruler clean and record the splash height after other rainfalls. Does it vary? Discuss.

9. How does the wind affect the surface of the earth?
Smooth and dry the sand in the playground sandbox or bring a shallow box filled with sand to the classroom. Place an electric fan in a position to blow on the sand. Observe what happens. Experiment by placing stones and small fences on the sand and see how these affect the pattern in which the sand is distributed.

10. Why does water carry away so much soil?
Put a few inches of soil into a quart jar and add two cups of water. Shake vigorously. Examine the water periodically during the day and the following days and note the rate at which the soil settles. Does it ever settle completely?

Recent Books

Level	
C	Bendick, Jeanne. THE WIND. Rand McNally. Chicago. 1964. $2.95.
C	Lauber, Patricia. JUNIOR SCIENCE BOOK OF VOLCANOES. Garrard. Champaign. 1965.
B	Tangborn, Wendell. GLACIERS. Crowell. New York. 1965. $2.95.
C	Werner, Elsa. THE GOLDEN GEOGRAPHY. Golden Press. New York. 1964. $3.95.

Teacher References

1. Sourcebook, Chapter 8.
2. NSTA, Volume 2, The Earth.
3. UNESCO, Chapter V.

Free Films

1. The Fossil Story, 19 min., Shell Oil Company.
2. Paricutin (Volcano), 18 min., Department of the Air Force.

EXPLORATION XXIII

WHAT CAN WE LEARN ABOUT THE AIR AROUND US?

Purpose

The purpose of this lesson is to make the children aware of the air which surrounds them and the nature and characteristics of that air.

Main Ideas

1. An atmosphere of air surrounds the earth.
2. Air is a substance which has weight and occupies space.
3. Air is made up of a variety of gases.

Television Presentation

Referring back to the three states of matter, air will be cited as an example of the gaseous state. Several demonstrations will be given to illustrate that air has weight and takes up space. After exploring the ways in which we know that air is all around us, the nature of the atmosphere will be investigated and the question of why the sky is blue will be examined.

Jumping Off Point

Having had their attention drawn toward the air which surrounds them, the way is open for further examination and observation through directed activities and experiments.

Related Activities

1. Does air occupy space and have weight.

   Weigh a deflated football or basketball. Pump air into it and weigh it again. Does this help to answer the above question?

2. Where is air found?

   Have the children dip a variety of objects and substances into a tub of water. Which ones emit air bubbles? Use sawdust, soil, sugar cubes, wood, sponge, etc.

3. Does air occupy space?

   Place a handkerchief in a water glass. Invert the glass and submerge it in a pan of water. Remove it. Is the handkerchief wet? Discuss.

4. Does air have weight?

   Tie a large inflated balloon on each end of a yardstick. Tie a string around the center of the yardstick and hang it from some overhead support. Balance the yardstick so that it is level. Break one of the balloons with a pin. Steady the stick. Is the yardstick still level? Does air have weight?

5. Does the atmosphere apply pressure on the surface of the earth?

   Place a thin stick (about three feet long) on a table with about half a foot extending over the edge of the table. Open a newspaper to its full spread and lay it on the stick. After flattening the paper carefully, strike the stick with a sharp blow using a heavier stick, pipe, or hammer. Discuss the results.

6. Does the atmosphere apply pressure?

Put about an inch of water into a can with a screw top. Leaving the can open, put it on a stove and heat the water until it boils vigorously. Remove the can from the stove. Screw the lid on tightly and observe what happens. The process can be speeded up by pouring cold water over the can. Explain your observations.

7. Does the atmosphere apply pressure?

Fill a drinking glass with water and place a piece of cardboard over the top. Hold the cardboard in place while the glass in inverted. Once inverted, remove your hand from the cardboard. What happens? Explain.

8. Is there air in water?

Fill a glass with fresh water and allow it to stand in a warm place. Observe it from time to time. Does anything happen which helps to answer the question?

9. What gases make up air?

Go to the library and find a book which tells what gases make up air. Investigate just what each of these gases is like and what it is used for. Prepare a chart about each one which shows its characteristics and uses.

10. How is air important to burning?

Light four identical candles. At a given signal, have the children cover one of them with a pint jar, one with a quart jar, one with a gallon jar, and leave one uncovered. What happens? Explain.

Recent Books

Level

C Bendick, Jeanne. THE WIND. Rand McNally. Chicago. 1964. $2.95.

C Roberson, Paul. CHEMISTRY BY EXPERIMENT. John Day. New York. 1965. $2.50.

Teacher References

1. Sourcebook, Chapter 9.
2. NSTA, Volume 2, The Earth.
3. UNESCO, Chapter VII.

Free Films

None

EXPLORATION XXIV

WHAT CAN WE LEARN ABOUT THE WEATHER?

Purpose

The purpose of this lesson is to stimulate the children to examine variations in weather and their causes.

Main Ideas

1. The temperature of the earth varies from day to day and from season to season.
2. Weather changes are due to changes in the atmosphere which result from forces that act upon it.

Television Presentation

This first of two lessons on the weather will begin with an opportunity for the children to view many kinds of weather. Next, after the children have had time to speculate on the reasons for the various seasons of the year, the relationship of the earth to the sun during each of the seasons will be discussed. Various types of climates will be illustrated and the nature of different climates explored. Finally, the atmosphere in which weather changes occur will be investigated.

Jumping Off Point

As a result of topics introduced in this lesson, the opportunity is open to explore further such areas as seasons, climate, the atmosphere, and the entire range of weather phenomena.

Related Activities

1. What causes winds?

Use a narrow strip of thin, light paper to explore wind currents. Hold it above the burner of a stove, over a radiator, and beside the opening at the top and bottom of a window which is ventilating a room. Discuss your observations.

2. How does moisture get into the air?

In order to demonstrate that moisture enters the air from the soil, fill a flower pot with moist soil and weigh it. Weigh it again the following day. Discuss the results.

3. How does moisture get into the air?

Place a plastic bag over a plant and tie it close to the stem at the base. Examine it carefully after about an hour. Discuss your observations.

4. How is rain produced?

Hold a pan of ice water about six inches above a pan of boiling water. What is observed? How does this relate to rain and how rain is produced?

5. What causes dew?

Fill a tin can with ice water. Observe the can for a few minutes. What happens? How can this be related to the above question?

6. What are some of the important types of clouds?

Locate a book which illustrates various cloud types. Have the children, using cotton, rubber cement, and blue paper for a background, prepare and display models of these various cloud types.

7. How do scientists study and predict the weather?

Cut the daily weather maps from the newspaper and put them on the bulletin board. Explore the meaning of the various symbols on the map.

8. What types of weather do you have where you live?

Have the children list all of the types of weather conditions which they experience. Prepare a bulletin board or chart with the list and illustrations of each item on the list.

9. What damage can violent storms cause and what precautions should be made for them?

Have someone from the community, perhaps a civil defense official, come to the school and talk with the class about tornadoes and hurricanes and precautions which should be taken if they threaten your area.

10. Why does temperature vary with the season?

Using a flashlight to represent the sun and a globe to represent the earth, demonstrate how the sun's rays strike the earth during each season. Discuss the reasons for temperature variations from season to season.

Recent Books

Level	
C	Bendick, J. THE WIND. Rand McNally. Chicago. 1964. $2.95.
B	Evans, E. THE SNOW BOOK. Little, Brown. Boston. 1965. $3.25.

Teacher References
1. Sourcebook, Chapter 7.
2. NSTA, Volume 2, The Earth.
3. UNESCO, Chapter VIII.

Free Films
1. Tornado, 15 min., U.S. Weather Bureau.
2. Unchained Goddess (Weather), 60 min., Bell System Telephone Offices.
3. Weather Men of the Sea, 14 min., U.S. Coast Guard.
4. Winds That Kill (Hurricanes), 13 min., U.S. Weather Bureau.
5. You and the Weather, 25 min., Texaco, Inc.

EXPLORATION XXV

HOW ARE WEATHER MEASUREMENTS MADE AND FUTURE WEATHER PREDICTED?

Purpose

The purpose of this lesson is to acquaint the children with the types of measurements which are made of weather phenomena and how they are used in predicting the weather.

Main Ideas

1. A variety of instruments are used to make measurements of weather occurrences.
2. Weather can be predicted as a result of combining information from measurements and observations.
3. Accurate weather predictions are essential for planning for work and recreation.

Television Presentation

Following an introduction to the nature and importance of weather forecasting, the children will be shown some of the types of equipment which are actually used to record and predict the weather. Several homemade weather instruments will be demonstrated with directions on how the children can make them and assemble a homemade weather station. The importance of observations to weather forecasting will be discussed with emphasis placed on identifying cloud formations.

Jumping Off Point

The children will be encouraged to construct simple weather instruments and make observations of the weather.

Related Activities

1. How do scientists study the weather?

Visit a nearby weather station.

2. How do scientists study and predict the weather?

Cut the daily weather maps from the newspaper and put them on the bulletin board. Prepare a legend which indicates the meaning of each of the symbols which appears on the map.

3. How accurately are scientists able to predict the weather?

Cut the weather forecast from the newspaper each day and mark on it whether or not it was correct. After several days, calculate the ratio of the number of times it was correct to the number of times it was incorrect.

4. How can you learn about the weather?

Search through books in the library and find ways of making simple weather instruments. Regular observations can then be recorded of wind direction, rainfall, temperature, etc. The opportunity is then available to calculate total rainfall, average rainfall, temperature range, average temperature, etc.

5. Who is interested in receiving weather predictions?

Have the children suggest reasons why weather predictions are so important. What businesses, workers, and individuals need this information and why? Perhaps a bulletin board can be prepared on the subject.

6. What can you learn about weather sayings and superstitions?

Have the children collect as many weather sayings and superstitions as they can. How many have some validity? Investigate them as thoroughly as possible. Perhaps there is a book in the library on the subject.

7. How can the wind velocity be determined?

Check in the school library for a book about weather which contains the "Beaufort Scale" for determining wind speed. Prepare a chart on which you can record the wind speed at a particular time of day for several days. Each day at that time, use the Beaufort Scale to estimate the wind speed and enter it in the chart. A note should also be made of wind direction.

Recent Books

Same as Exploration XXIV.

Teacher References

1. Sourcebook, Chapter 7.
2. NSTA, Volume 2, The Earth.
3. UNESCO, Chapter VIII.

Free Films

Same as Exploration XXIV.

EXPLORATION XXVI

WHERE IS THE EARTH IN SPACE?

Purpose

The purpose of this lesson is to introduce the children to an understanding of the solar system and the position of the earth in the solar system.

Main Ideas

1. The earth is one of nine planets in the solar system.
2. The planets vary in size and distance from the sun.
3. The planets move around the sun.

Television Presentation

After viewing several areas of the world of science which have already been explored, an examination will be made of our place in the solar system. Attention will be focused on what makes the sun shine, the reasons for night and day, the nature of the planets in our solar system, and the relative positions and motion of the sun, moon, and planets.

Jumping Off Point

With this introductory lesson, a perspective is given for the position of the earth in the solar system. This provides a setting for observations and activities which will give the children a better understanding of the makeup of the solar system and the earth's relation to it.

Related Activities

1. What evidence do we have that the earth moves around the sun?

   Using a light bulb to represent the sun and a globe to represent the earth, move the globe around the bulb and demonstrate how the reasons for the different seasons of the year can be explained by this rotation.

2. What causes an eclipse?

   Using a light for the sun, a tennis ball for the moon, and a volleyball for the earth, move them relative to one another until they demonstrate the reasons for a solar and a lunar eclipse.

3. Why does the moon appear with different shapes at different times of the year?

   In a darkened room, shine a flashlight at a white ball from different angles and have the children suggest reasons why the moon appears to have different shapes at different times of the month.

4. How does the moon appear to change during the month?

   Have the children prepare a calendar on a sheet of paper with a block of space for each day of the month. Each night that the moon is visible during the month, have the children draw it in the appropriate block. Discuss the changes and the reasons for these changes.

5. How do the planets vary in size?

Prepare a bulletin board, clay models, or suspend models of the planets from the ceiling which demonstrate the relative sizes of the planets. Many books suggest convenient comparative sizes. If these cannot be located, find the actual diameters and list the planets in order of size before making the models accordingly.

6. What are the relative distances of planets from the sun?

Prepare a bulletin board, clay models, or suspended models of the planets from the ceiling which demonstrate the relative positions of the planets in the solar system. Many books suggest relative distances for such models. If these cannot be located, at least the order of their distance from the sun can be represented.

7. What can you find out about the sun, the moon, and the planets?

Have the children gather as much information as they can about the sun, moon, and each of the planets. Prepare a chart about each one. Such things as size, nature of surface, distance from other parts of the solar system, existence of life, etc. can be included.

8. What does the surface of the moon look like?

Examine the moon with binoculars or a telescope. Make drawings of some of the features which are noted. Make a clay or plaster of paris model of the moon showing some of the features which were observed.

9. How did the planets get their names?

Make a list of the names of the planets. What do all of these names have in common? What can you find out about each one?

Recent Books

Level

B	Branley, F. A BOOK OF THE MILKY WAY GALAXY AND YOU. Crowell. New York. 1965. $3.75.
C	Moore, Patrick. THE PICTURE HISTORY OF ASTRONOMY. Grossett and Dunlap. New York. 1964. $6.95.
B	Shapp, M. and C. Shapp. LET'S FIND OUT ABOUT THE MOON. Watts. New York. 1965.
B	Shapp, M. and C. Shapp. LET'S FIND OUT ABOUT THE SUN. Watts. New York. 1965.

Teachers References

1. Sourcebook, Chapter 10.
2. NSTA, Volume 6, Space.
3. UNESCO, Chapter VI.

Free Films

1. Our Mr. Sun, 60 min., Bell System Telephone Offices.
2. Universe, 23 min., National Aeronautics and Space Administration.

EXPLORATION XXVII

WHERE ARE THE EARTH AND SOLAR SYSTEM IN SPACE?

Purpose

The purpose of this lesson is to provide the children with a view of the broad expanses of the universe and the position of the earth in the universe.

Main Ideas

1. The sun in our solar system is but one of many stars in a galaxy of stars.
2. Our galaxy is but one of many galaxies in the universe.
3. Stars shine in the sky with light which they produce.
4. Stars are often identified in patterns to which men have assigned names.

Television Presentation

This lesson will take the children beyond the earth and beyond the solar system to the vast universe of stars. To be explored will be such topics as The Milky Way, why stars appear to twinkle, the patterns of stars called constellations, why stars appear to be different colors, and the nature of shooting stars. An opportunity will be provided for the children to identify a few familiar constellations.

Jumping Off Point

Having been introduced to the makeup of the universe, the children will be urged to observe and learn more about the stars.

Related Activities

1. Can you find some of the common constellations in the night sky?

   Using a book or with the help of someone familiar with them, find some of the familiar constellations in the night sky.

2. How can you prepare maps of some of the constellations?

   Using spots of white paint or white paper on black construction paper, make star maps of some of the constellations and put them on the bulletin board for others to identify.

3. Why can't we see the stars in the daytime?

   Darken the room and have one of the children shine a flashlight from the front of the room. Can the light be seen clearly? Turn on the lights and raise the shades and shine the flashlight again. Can it be seen as clearly as before? Next, have the child go outside on the school grounds in a place where he can be seen from the window and shine the light again. Can it be seen as clearly as before? Does this help to answer the question?

4. How can you prepare maps of the constellations?

   Cut out several squares of cardboard which will fit into a slide projector. Have the children put patterns of constellations on them by punching holes in them with pins. Project the constellations on a screen and use them for drills and explanations.

5. How can you get practice in becoming familiar with constellations?

Secure several cardboard tubes (mailing, paper towel, or tissue tubes). Cover one end with black construction paper or aluminum foil held in place with a rubber band. Have the children put patterns of constellations on them by punching holes in the paper or foil with pins. Label the tube with the name of the constellation. By looking through the tube toward a light the children can become acquainted with the patterns of the different constellations.

6. Why do people on other parts of the earth see different stars from the ones which we see?

Try to locate a book which shows the stars that can be seen from the northern hemisphere and those that can be seen from the southern hemisphere. Why do they differ? Using a globe, have the children discuss why a person in South America would see different stars than would be seen by a person in the United States.

7. How can the relative position of stars in a constellation be demonstrated?

Cut out paper stars and hang them from the ceiling in the pattern of a constellation. Use different lengths of thread. In this way, as the children look up at them from below they can see that they form the pattern of a particular constellation, but when they look at them from across the room, they can see that they do not exist on an even plane.

8. What are some of the stories which relate to the constellations?

Have the children try to find out why various constellations were named as they are and the stories which relate to these names.

9. How can you make a simple planetarium?

Obtain an old black umbrella and stand it up by putting the handle into a hole in a block of wood. As the children learn a new constellation, mark it in its relative position on the inside of the umbrella with chalk or white paint. Light lines can be drawn to join the stars of a constellation.

Recent Books

Same as Exploration XXVI.

Teacher References

1. Sourcebook, Chapter 10.
2. NSTA, Volume 6, Space.
3. UNESCO, Chapter VI.

Free Films

Same as Exploration XXVI.

EXPLORATION XXVIII

WHAT DEVICES DOES MAN USE TO EXPLORE SPACE?

Purpose

The purpose of this lesson is to make the children aware of the wide variety of methods and devices which scientists have for use in exploring space.

Main Ideas

1. Because of the great distances involved, special techniques have had to be developed for exploring space.
2. Optical and radio telescopes receive light and signals from space.
3. A wide variety of satellites and spacecraft have been launched from the earth for the purpose of exploring space.

Television Presentation

Following a description of misconceptions which were once held concerning the nature of the universe and the earth's position in it, devices will be described which enable man to observe and explore the universe in order to more accurately chart its true nature. Included among these instruments will be refracting telescopes, reflecting telescopes, radio telescopes, rockets, satellites, spacecraft, and manned space vehicles.

Jumping Off Point

The next step is for the children to explore how the various types of telescopes work and the means, reasons, and results of rocket propelled space probes.

Related Activities

1. What are the important parts of a telescope?

Have the children bring an assortment of magnifying glasses to class. Working in groups, have them experiment with looking through two lenses while adjusting the distance between them. Check on which group comes up with the best telescope. Lenses can be mounted in cardboard tubes which slide back and forth in one another for the purpose of focusing.

2. How can a mirror be used in a telescope?

Have the children look into a shaving mirror or some other reflecting surface which curves inward. What do they notice? Discuss its application to the telescope.

3. How can a radio telescope be used to study the stars?

Discuss with the children how lightning or other electrical interference causes static on a radio. See if they have any ideas about why this is so. Suppose some sort of electrical disturbance was taking place on a star out in space somewhere and we had an antenna and radio sensitive enough to detect it. Discuss how this could be used to study the stars.

4. What spacecraft have been used to explore space?

Prepare a chart or bulletin board of pictures of satellites and spacecraft which have been launched from the earth. Pictures can be obtained from old newspapers and magazines or by writing to NASA.

5. What are some of our reasons for launching spacecraft?

Have the children investigate some of the reasons for placing satellites into orbit, launching space probes, and sending men into orbit. Prepare charts to illustrate some of these reasons.

6. Who are some of our space explorers?

How many astronauts can the children name? List them and, if pictures can be found, prepare a chart or bulletin board.

7. What space exploration is presently going on?

Have the class start a log of satellite launchings and space probes. On a special scrap book, have them record the date, purpose, and other pertinent information about such probes as they happen. Newspaper clippings can also be entered under each record.

8. Can you dramatize the launching of a satellite?

Having seen rocket launchings so often on television, have the children take the roles of the technicians involved and dramatize the preparation and launching of a satellite. The props which could be prepared for this are almost unlimited.

Recent Books

Same as Exploration XXVI.

Teacher References

1. Sourcebook, Chapters 10 and 26.
2. NSTA, Volume 6, Space.
3. UNESCO, Chapters VI and XVI.

Free Films

Obtain a film listing from the National Aeronautics and Space Administration.

EXPLORATION XXIX

HOW ARE ROCKETS ABLE TO TRAVEL INTO SPACE?

Purpose

The purpose of this lesson is to acquaint the children with what rockets are and how they work.

Main Ideas

1. Rockets are used to propel satellites and spacecraft from the earth.
2. Rockets work on the principle that an action in one direction produces a reaction in the other direction.

Television Presentation

Following a brief introduction to rockets, several demonstrations will be performed to illustrate Newton's law of action and reaction. After each demonstration, time will be provided to permit the children to discuss with their teachers what they saw. The relationship of this scientific law to the flight of a jet airplane will be examined.

Jumping Off Point

Having been made aware of the operation of rockets, the children will be urged to watch newspapers, books, and magazines for different types of rockets and to perform experiments which will help them to understand how rocket propulsion works.

Related Activities

1. What are some of the types of rockets which are being used in our space program?

Have the children gather as many pictures and as much information as they can about the various rockets which are being used in our space program. Prepare a chart on each rocket reported upon.

2. Who were some of the men who were important to the development of rockets?

Have the children locate information on Konstantin E. Tsiolkovsky, Robert Goddard, Wernher von Braun, and other scientists who contributed to the development of rockets.

3. On what principle do rockets operate?

Have the children blow up balloons and then release them. What happens? Discuss.

4. On what principle do rockets operate?

Suspend a test tube from a support by means of a wire which is wrapped around the support loosely so that the test tube is free to swing back and forth. Put a small amount of water in the test tube, a stopper loosely but firmly in the end, and balance it horizontally but tilted slightly so that the water runs to the bottom. Place a source of heat under the water and stand back. Observe what happens. Be careful that the stopper is not aimed toward anyone.

5. On what principle do rockets operate?

Have a child stand on a skate board holding a basketball. Have him throw the ball as hard as he can. What happens?

6. On what principle do rockets operate?

Adjust a hose nozzle to produce a stream of water at maximum pressure. Place the hose on the ground and turn on the water faucet all the way. What happens? Have the children hold the hose as it is turned on and off and describe what they feel. Discuss.

7. On what principle do rockets operate?

Place two marks on the floor about 20 feet apart. Midway between them put two skate boards. Have two children stand on the boards and, placing their palms together, push apart so that they roll toward the marks. Which one reaches a mark first? Repeat the experiment several times with other children. Is there any relationship between the weight of the children and which one reaches a mark first?

8. Why is some type of guidance system necessary for a rocket?

Repeat activity three. Can you get the balloons to go where you want them to? Extend a ten foot piece of thread between two chairs. Pass the thread through a drinking straw before tying the string to the chairs and tape the straw to the side of an oblong, inflated balloon. Release the balloon. Discuss.

9. How can a rocket or spacecraft be kept from tumbling in space?

Allow the children to play with a gyroscope and perform the usual experiments with it. Relate it to the above question.

Recent Books

Level

C Bergaust E. ILLUSTRATED SPACE ENCYCLOPEDIA. Putnam. New York 1965.
C Coombs C. PROJECT APOLLO: MISSION TO THE MOON. Morrow. New York 1965.
C Coombs, C. ROCKET PIONEER. Harper and Row. New York. 1965.
B Crosby A. THE WORLD OF ROCKETS. Random. New York. 1965.
C Pacilio J. DISCOVERING AEROSPACE. Children's Press. Chicago. 1965.
C Scharff R. INTO SPACE WITH THE ASTRONAUTS. Grossett and Dunlap. 1965.
C United Press International. GEMINI. AMERICA'S HISTORIC WALK IN SPACE. Prentice-Hall. Englewood Cliffs, New Jersey. 1965.

Teacher References

1. Sourcebook. Chapters 25 and 26
2. NSTA, Volume 6. Space.
3. UNESCO, Chapters XI (E)

Free Films

1. ABC of Jet Propulsion, 17 min., General Motors Corporation.
2. Obtain a listing from the National Aeronautics and Space Administration.

EXPLORATION XXX

HOW AND WHY DO ASTRONAUTS TRAVEL INTO SPACE

Purpose

The purpose of this lesson is to explore some of the problems, phenomena, and purposes of manned space flights.

Main Ideas

1. Man's scientific curiosity has led him to explore space as a new frontier.
2. In order to explore space, man must overcome problems of gravity, temperature, radiation, and weightlessness.
3. In order to explore space, man must take with him everything which he needs for life.

Television Presentation

This lesson will center around the requirements for safe space flight and how these requirements can be met. Film will be used to show a child performing an activity followed by an opportunity for the children in the classroom to discuss the relationship of that activity to space travel. Examples will then be shown to illustrate how the activity is carried out in space. Such factors as eating, drinking, breathing, controlling body temperature, and protecting the body from radiation and foreign objects are among the topics to be considered.

Jumping Off Point

Having been introduced to the purposes, needs, and problems of manned space flight, the children should now be more aware of the presence of these activities in the news and prepared to make investigations which would promote a better understanding.

Related Activities

1. What atmospheric pressure is a man's body accustomed to?

Put about an inch of water into a can which has a tight fitting lid. Leaving the can uncovered, heat the water to boiling. Remove the can from the heat. Screw the cap tightly on the can and allow it to cool. Since the air inside of the can has been replaced with steam, as the steam condenses into water there will be little air pressure exerted from the inside. Evidence of the pressure on the outside will become increasingly apparent. Since the human body is accustomed to this type of pressure, what would happen if a man was sent into space where the pressure does not exist? What measures are taken to protect our astronauts? Discuss.

2. How necessary is air to maintaining human life?

Have each child determine how long he can hold his breath. Caution them not to hold it so long that they may become ill. Discuss this in relation to traveling into space where there is no air. What provisions are made for supplying air to astronauts?

3. How can air be provided during extended space flights?

Obtain a water plant from an aquarium, pond, or stream. Place a jar of water upside down over the submerged plant and put it into the sunlight. Over a period of time, have the children observe the formation of bubbles and the collection of gas in the inverted jar. Discuss this experiment in relation to supplying air to astronauts on a space flight.

4. What are some of the problems of providing food for space travelers?

Leave such things as milk, meat, moist bread, and lettuce in a warm room and have the children keep a check on what happens to them. Discuss their observations in relation to the problems involved in providing food for astronauts. What are some of the ways in which food is preserved for space flights?

5. How can the temperature of a spacecraft be controlled?

Using two identical tin cans, fill them half full with water and cover one with black paper and one with white paper. Put them in the sun and check their temperatures from time to time. From the observations which are made, what color would you make a manned spacecraft which is being sent out into space? Is there any advantage to having one side white and one side black? Discuss.

6. What is radiation and how can astronauts be protected from it?

Borrow a Geiger counter from the local high school or civil defense unit. If no other radiation source is available to use with it, a luminous dial clock can be used. Demonstrate with the Geiger counter and radiation source that radiation is being emitted and explain that a similar type of radiation is present in space.

7. How can a state of weightlessness be avoided in a manned space station?

Put a doll and a few objects in a jar. Throw it in the air and catch it a few times. Notice how, at the moment you catch the jar, the doll and objects are floating on the inside. This is what would happen inside a space station unless special precautions are taken.

Tie a heavy string or wire through holes punched in the lid of the jar and swing it around you. Do the objects still float in the jar? Discuss how this type of motion in a space station could produce a form of artificial gravity.

8. What is it like to take a trip into space?

Have the children prepare a dramatization of a trip into space. Have them include in it everything which they have learned about space, rockets, and manned space flight. The possibility exists to develop rather extensive props, sets, and costumes or to do it quite simply.

Recent Books

Same as Exploration XXIX.

Teacher References

1. Sourcebook, Chapters 25 and 26.
2. NSTA, Volume 6, Space.
3. UNESCO, none.

Free Films

Same as Exploration XXIX.

EXPLORATION XXXI

WHAT HAVE WE LEARNED ABOUT THE WORLD OF SCIENCE?

Purpose

The purpose of this lesson is to look back over previous experiences of the year and draw them together to produce an integrated picture of science.

Main Ideas

1. Science is concerned with the study of everything in our surroundings.
2. Scientists learn by exploring their surroundings.

Television Presentation

This lesson will be almost identical to Exploration I except that the order of the lesson segments will be changed. The order of the first two segments, as described under Exploration I, will be inverted.

The reason for repeating this lesson is to enable the classroom teachers to gain an insight into the progress which the children have made during the school year. This progress should become evident through the level of sophistication of the comments which the children make during the lessons.

The lesson is designed to leave the children with the realization that, although they have learned a great deal about the world of science during the past year, there is still a need for more exploration because there remains a great deal that they do not know.

Jumping Off Point

The children will be left with the challenge to recall and relate the things which they have explored and to raise questions about the world of science about which they are still curious.

Related Activities

1. What have you learned about the world of science?

Cut out a large circle of paper to represent the world of science and mount it on the bulletin board. Have the children mount on and around it words, phrases, and illustrations which represent things that they learned during the year.

2. What things do you wonder about the world of science?

Have the children list some of the questions which they have about science. These questions need not be answered. They may be used to emphasize the need for more exploration of science in the years to come.

3. What have you learned in your explorations?

Have the children write letters about their experiences with science during the year and send them to the sponsors of the televised series.

4. How can you explore science during the summer?

Discuss with the children science activities and projects which they can carry out during the summer.

5. What books can you read which will help you to explore science?

If the school has made provision for the children to check out books during the summer, acquaint them with some of the science books available to them. If not, perhaps a representative of the community library could come to the school and acquaint them with what is available to them there.

Recent Books

Refer to all other Explorations.

Teacher References

1. Sourcebook, entire book.
2. NSTA, entire series.
3. UNESCO, entire book.

Free Films

All previous listings.

APPENDIX A

ADDRESSES OF FREE FILM SOURCES

American Petroleum Institute
Committee on Public Affairs
1271 Avenue of the Americas
New York, New York 10020

Bell System Telephone Office
Call your local Bell business office

B. F. Goodrich Company
Public Relations Department
Akron, Ohio 44318

Bureau of Mines
U.S. Department of Interior
Graphic Services
4800 Forbes Avenue
Pittsburgh, Pennsylvania 15213

Bureau of Sport Fisheries and Wildlife
800 Peachtree - Seventh Building
Atlanta, Georgia 30323

California Chemical Company
Advertising and Public Relations
200 Bush Street
San Francisco, California 94104

Canadian Travel Film Library
680 Fifth Avenue
New York, New York 10019

Copley Productions
434 Downer Place
Aurora, Illinois 60506

Davey Tree Expert Company
Kent, Ohio 44240

Department of the Air Force
Air Force Film Library Center
8900 South Broadway
St. Louis, Missouri 63125

Eastman Kodak Company
Audio-Visual Service
343 State Street
Rochester, New York 14650

Evinrude Motors
Contact your local Evinrude dealer

Fish and Wildlife Service
U.S. Department of Interior
Bureau of Commercial Fisheries
Audio-Visual Services
1815 North Fort Myer Drive
Arlington, Virginia 22209

General Motors Corporation
Public Relations Staff, Film Library
General Motors Building
Detroit, Michigan 48202

Illinois Natural History Survey
189 Natural Resources Building
Urbana, Illinois 61803

Information Service of India
Embassy of India
2107 Massachusetts Avenue, N.W.
Washington, D. C. 20008

Kaiser Aluminum and Chemical Corporation
Public Affairs Department, Room 864
300 Lakeside Drive
Oakland, California 94604

Marineland of Florida
Public Relations Department
Route 1, Box 122
St. Augustine, Florida 32084

Modern Talking Picture Service
501 College Street
Charlotte, North Carolina 28202

National Aeronautics and Space Administration
Code AFEE-3
Washington, D. C. 20546

Roses, Incorporated
217$\frac{1}{2}$ Ann Street
East Lansing, Michigan 48823

Sante Fe Film Bureau
80 East Jackson Boulevard
Chicago, Illinois 60604

Shell Oil Company
Film Library
149-07 Northern Boulevard
Flushing, New York 11354

Smithsonian Museum Service
Smithsonian Institution
Museum of History and Technology
CMB06, TV Studio
Washington, D. C. 20560

Sterling Movies U.S.A., Inc.
43 West 61st Street
New York, New York 10023

Swedish Film Center
Department of Creativision, Inc.
1780 Broadway
New York, New York 10019

Texaco, Inc.
Sales Promotion Manager
P.O. Box 1722
Atlanta, Georgia 30301

Thomas J. Barbre Productions, Inc.
Library Division
2130 South Bellaire Street
Denver, Colorado 80222

U.S. Coast Guard
Public Information Division
Washington, D. C. 20226

U.S. Weather Bureau
Film Library
24th and M Streets, N.W.
Washington, D. C. 20235

National Bureau of Standards
Office of Technical Information
Washington, D. C. 20234

APPENDIX B

PHONOGRAPH RECORDS

Several phonograph records have been found to be useful in teaching about science in the primary grades. Some of these are listed below. They can be purchased through record stores and various school science supply dealers. One source which stocks all of them is Nasco Science Materials, Fort Atkinson, Wisconsin, 53538.

The songs which are used in the television lessons appear on the records in the series "Ballads for the Age of Science." Each record in this series contains approximately fifteen science songs. The cost of individual records in the series is about four dollars. The entire series of six records costs approximately twenty dollars.

- Ballads for the Age of Science (series of six records)
  - Space Songs
  - Energy and Motion Songs
  - Nature Songs
  - More Nature Songs
  - Weather Songs
  - Experiment Songs

- Nature Records
  - American Bird Songs
  - Birds on a May Morning
  - Brook (The) (Sounds of birds and animals)
  - Insect Sounds
  - Songbirds of America
  - Songs of the Forest
  - Song Sparrow
  - Sounds of Frogs and Toads
  - Spring Morning
  - The Swamp in June

- Space Record
  - Voices of Satellites